



INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

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JOURNAL

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1938. VOL. LVIII. SERIES III.

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R. S. CLAY, B.A., D.Sc., F.Inst.P.	1936-37

* Deceased.

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 NOTICES OF NEW BOOKS,
 AND THE
 PROCEEDINGS OF THE SOCIETY

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December, 1938

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- 1914 Akehurst, Sydney Charles.
50, *Grasmere Road, Muswell Hill, N.10.*
- 1905 *Allis, Edward Phelps, jun., C.E., LL.D., F.L.S., F.Z.S.
Palais Carnolès, Menton, Alpes Maritimes, France.
- 1938 Alves, William.
Public Health Laboratory, Box 1183, Salisbury, Southern Rhodesia.
- 1926 Armitage, Rev. John James Richard.
St. Leonard's Vicarage, Peel Road, Bootle, Liverpool, 20.
- 1924 Armstrong, Robert William, F.S.M.C., F.I.O.
c/o South African General Electric Co., Hot Point House, Johannesburg, South Africa.
- 1929 Ashby, Thomas Charles.
40, *Ashlyns Road, Berkhamsted, Herts, and Government Laboratory, London, W.C. 2.*
- 1922 Atwell, Stanley Ernest, F.B.O.A.
57, *Wentworth-avenue, Church End, Finchley, N. 3.*
- 1934 Aumonier, Frederic John.
21, *Ashburnham-avenue, Harrow, Middlesex.*
- 1932 Austin, Reginald George, B.Sc., A.I.C.
Chemistry Department, Municipal College, Portsmouth, Hants.
- 1923 Baber, Frederick William.
6, *Green-walk, Wood-road, Whalley Range, Manchester.*
- 1933 Bailey, Roland Henry.
Farleigh End, Farleigh Common, Warlingham, Surrey.

Elected.

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Council, etc.

- 1908 Baird, Thomas Stewart, F.I.O., F.S.M.C., D.B.O.A.
70, *Bothwell Street, Glasgow, C.2.*
- 1915 Baker, Arthur.
"Yews," *New Barn, Longfield, Kent.*
- 1885 Baker, Frederick Henry, F.L.S.
167, *Hoddle-street, Richmond, Victoria, Australia.*
- 1894 Baker, Frederick William Watson, F.Inst.P.
313, *High Holborn, W.C. 1.* 1909-11; 1914-15
- 1914 *Baker, Wilfred E. Watson, A.Inst.P.
313, *High Holborn, W.C. 1.* 1921-23; 1929-30;
Cur. Inst. 1921-1936
- 1882 Bale, William Mountier.
83, *Walpole-street, Kew, Victoria, Australia.*
- 1926 Balfour-Browne, Professor W. A. F., M.A., F.R.S.E., F.Z.S.,
F.R.E.S. 1930-33;
V.-P. 1933-34;
1936-37
Pres. 1934-35
Hook Place, Burgess Hill, Sussex.
- 1936 Ballard, Alfred Charles.
Hill House, 31, Links Road, Epsom, Surrey.
- 1935 Banerjee, Gyanendra Nath, B.Sc.
c/o *The Scientific Instrument Co., Ltd., 240, Hornby
Road, Bombay.*
- 1895 Barnard, Joseph Edwin, F.Inst.P., F.R.S., *President.*
Walwens, Eastbury-road,
Oxhey, Herts. 1910-12; 1937
Cur. 1913;
V.-P. 1913-14;
1916-17; 1934-36;
Hon. Sec. 1920-27;
1930-33
Pres. 1918-19;
1928-29; 1938-
- 1923 Barrett, Alfred.
The Chalet, Compton-road, Winchmore-hill, N. 21.
- 1931 Bartlett, Charles Henry.
Tenterden, 71, Alexandra-avenue, Luton, Beds.
- 1921 Batchelor, Arthur James.
Croftside, 3, Ivyday-grove, Streatham, S.W. 16.
- 1899 Beale, Peyton Todd Bowman, F.R.C.S.
Lymore End, Everton, Lymington, Hants. 1905
- 1932 Beardsmore, Thomas Samuel.
The Knoll, Springfield-road, Hinckley, Leics.
- 1885 *Beck, Conrad, C.B.E.
69, *Mortimer-street, W. 1.* 1894-1906; 1912-18;
1923-24; 1931; 1937-
V.-P. 1907-08;
1934-36
Pres. 1932-33
- 1918 Berry, John Leslie, M.B., Ch.B.
151A, *New-street, Burton-on-Trent.*
- 1913 Bestow, Charles Horton, F.L.S.
Melford-house, 43, Upper Clapton-road, E. 5.
- 1937 Bhalerao, G.D., D.Sc., Ph.D., F.Z.S.
*Helminthologist, Imperial Institute of Veterinary
Research, Muktesar-Kumaun, U.P., India.*
- 1937 Bhanagay, Chandrakant Trimbak, B.A., LL.B.
*Handwriting and Ballistics Expert, Sitabuldi, Nagpur,
C.P., India.*

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1928	Blair, Duncan MacCallum, M.B., Ch.B. <i>Professor of Anatomy, The University, Glasgow, W.2.</i>	1932-33 V.-P. 1934-35
1903	*Blood, Maurice, M.A., F.C.S., F.P.S. <i>10, Park-avenue, Willesden Green, N.W. 2.</i>	1919-20
1926	Blunderfield, Henry Charles. <i>Royal Albert Edward Infirmary, Wigan.</i>	
1936	Boch, Alfred L. <i>30, Fifth Avenue, New York City, U.S.A.</i>	
1927	Borthwick, Sydney. <i>69, Mortimer-street, W. 1.</i>	
1921	Bowtell, Alexander James. <i>135, Dalston-lane, E. 8.</i>	
1932	Box, Harold Keith, D.D.S., Ph.D., F.A.A.P. <i>86, Bloor-street West, and 261, Winona-drive, Toronto, Ont., Canada.</i>	
1931	Boyle, Sydney, F.R.P.S. <i>Rivoli, North Albert-road, Norton-on-Tees, Co. Durham, and Research Laboratories, Imperial Chemical Industries, Ltd., Billingham-on-Tees.</i>	
1910	Bracewell, Geoffrey Alfred. <i>Newlands, Toller-lane, Bradford, Yorkshire.</i>	
1932	Bracey, Ronald John, F.Inst.P. <i>Morval, 15, Holmdene-avenue, Headstone-lane, North Harrow.</i>	1937-
1921	Bradbury, J. G., F.R.P.S. <i>1, Hogarth-hill, Finchley-road, Hendon, N.W. 11.</i>	1927-29
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1933	Brailsford, James. <i>20, Livingstone-road, Derby.</i>	
1924	Brambell, F. W. Rogers, B.A., D.Sc., Ph.D. <i>Professor of Zoology, University College of North Wales, Bangor.</i>	1927-29 ; V.-P. 1930-31
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1905	Bridge, John William. <i>Brewer-street, Maidstone.</i>	

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- 1932 Davies, Francis, M.D.
Professor of Anatomy, The University, Sheffield, 10.
- 1928 Davis, Osborne.
29, Westbourne-crescent, Canton Bridge, Cardiff.
- 1935 de Decker, Marcel Zénon Gustave Jean.
Rue Kronenburg, 41, Antwerp, Belgium.
- 1937 Dempsey, Mary, B.Sc.
83, Olive Road, London, N.W.2 and British Leather Manufacturers' Research Association, 18, St. Thomas Street, S.E.1.
- 1915 Denne, Mark Thomas, O.B.E., A.Inst.P.
72, Westbourne Terrace, W.2.
- 1936 Dent, Robert Vyvyan, F.R.P.S., F.R.G.S.
321, Avenue du Roi Albert, Shanghai.
- 1920 Derry, Douglas C. L., M.B., B.S. (Lond.).
10, Hamilton-terrace, St. John's Wood, N.W. 8.
- 1913 *Dinsley, Alfred, M.C., M.D.
Western Colloids, Research Division, P.O. Box 642, Glendale, Calif., U.S.A.
- 1935 Dixit, Mahendra Nath Bhalchandra, M.A., LL.B.
Anraoti, Berar, India.
- 1918 *Dixon, Miss Annie, M.Sc., F.I.L.S.
Kauguri, Batchwood-drive, St. Albans, Herts.
- 1919 Drescher, Theodore Bausch.
c/o Bausch and Lomb Optical Co., Rochester, N.Y., U.S.A
- 1929 Ducker, Robert Osborne.
27, Spurr-street, Sheffield.
- 1935 Dudley-Ward, Thomas William.
10, Bodiam Road, Streatham Vale, S.W.16.
- 1926 Dufty, Rev. Joseph Gibbins.
Meersbrook, Meikleriggs, Paisley.
- 1894 Duncan, Cecil Cooke, F.I.C., F.C.S.
42, Britannia Square, Worcester.
- 1911 Duncan, Francis Martin, F.R.P.S., F.Z.S.
19, Staverton-road, Brondesbury Park, N.W. 2
- 1919 *Dunn, Gano, A.I.E.E.
J. G. White Engineering Corporation, 43, Exchange-place, New York, U.S.A., and 550, Park Avenue, New York.
- 1935 Dunn, John Short, B.Sc., A.I.C.
Engineering Chemist, Public Works Department, Kumasi, Gold Coast.
- 1919 Dunn, Reginald.
90, Lorne-road, Clarendon Park, Leicester.
- 1922 Du Porte, E. Melville, Lecturer in Zoology and Entomology.
Macdonald College, Quebec, Canada.

1922-24 ; 1927-28 ;
1935-37 ;
Cur. Inst. 1937-
V.-P. 1925-26 ; 1938-

1917 ; 1920-23 ;
1936-37
V.-P. 1918-19 ;
Hon. Libr. 1920-24

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1920-30; V. P. 1916-
18; 1922; 1931-32

- 1910 Earland, Arthur.
Southwark, 58, Sheepcote Lane, Watford.
- 1934 Edwards, Alfred Samuel, F.L.S.
Pinehurst Heights Hotel, Witley, Surrey.
- 1935 Eisenberg, Moses Joel, D.M.D.
Fellow Dental Research, Dept. of Anatomy, Harvard Medical School, 25, Shattuck Street, Boston, Mass., U.S.A., and 444, Warren Street, Grove Hall, Roxbury, Mass., U.S.A.
- 1922 Ellis, Edward Henry, B.Sc. 1925-28
Gramarye, Farley Green, Albury, Surrey.
- 1925 Ellis, Holmes.
108, Birtwistle-avenue, Colne, Lancs.
- 1930 Ellis, William Neale, M.P.S.
Beachcroft, The Quay, Appledore, Devon.
- 1928 Else, Walter Martyn.
10, Eagle Parade, Buxton, Derbyshire.
- 1933 Evans, Alan.
Anilis, West Drive, Mickleover, Nr. Derby.
- 1897 Eyre, John W. H., M.D., M.S.Durh., D.P.H., F.R.S.E., 1904-08; 1909
V.-P. 1907-08; 1910
1922-23; 1927-28
Hon. Sec. 1911-19;
Pres. 1920-21;
Hon. Editor 1922-26
51, Portland-place, W. 1.
- 1931 Fairhall, Lawrence Turner, M.A., Ph.D.
Principal Industrial Toxicologist, United States Public Health Service, Washington, D.C., U.S.A.
- 1921 Falkner, Herbert John.
Gyfu, Barton, St. Mary Church, Torquay.
- 1883 *Fawcett, John Edward.
Heron Court, Farnham, Knaresborough.
- 1936 Fielding, John William.
School of Public Health and Tropical Medicine, The University, Sydney, Australia and 16, O'Briens Road, Hurstville, Sydney.
- 1928 Fikry, Mohammed Aziz, B.A., B.Sc., Ph.D.
Royal Agricultural Society, P.O. Box 63, Cairo, Egypt.
- 1925 Findlay, George Marshall, C.B.E., M.D., D.Sc. 1928-32; 1935-
Hon. Editor 1927-
V.-P. 1933-4
Wellcome Research Institute, Euston-road, N.W. 1.
- 1921 Flower, John W.
New Oxford House, Hart Street, London, W.C.1.
- 1935 Folkard, Henry Patrick, F.R.A.S.
1-11, Northwood Hall, Hornsey Lane, N.6.
- 1933 Ford, John.
Veterinary Laboratory, P.O. Bukuru, Nigeria, W. Africa, and c/o National Bank of India, 26, Bishopsgate, London, E.C. 2.

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- 1933 Fountain, Anthony Stuart.
Thornham, Fulwood Road, Sheffield.
- 1932 *Frankel, Jr., Edward, M.D., F.A.C.S.
217, East 17th Street, New York City, N.Y., U.S.A.
- 1932 Fraser, Roy, B.S.A., M.A.
Professor of Biology and Bacteriology, Mount Allison University, Sackville, New Brunswick, Canada.
- 1921 Frith, James Stretton, A.I.C., A.M.S.T.
c/o John Hare & Co., Ltd., Avon Street, Bristol.
- 1934 Fuge, Rev. Dingley P.
20, Scarborough-road, Shipley, Yorks.
- 1929 Fullard, Alfred Fairey.
29, Hopetown-avenue, Canterbury, Victoria, Australia.
- 1912 Gadd, Arthur.
12, Chadvil-road, Cheadle, Cheshire.
- 1918 Garbutt, Ernest Chalders.
York House, St. Ives, Cornwall.
- 1919 Garnett, John Benbow.
309, Oxford-road, Manchester.
- 1920 Gatenby, James Brontë, B.A., D.Phil. (Oxon), D.Sc. (Lond.).
Professor of Zoology, Trinity College, Dublin.
- 1922 Gater, Bossley Alan Rex, M.A., D.I.C., F.R.E.S.
Professor of Biology, King Edward VII College of Medicine, Singapore, Straits Settlements.
- 1922 Gates, R. Ruggles, M.A., Ph.D., LL.D., F.R.S., F.L.S.
Professor of Botany in the University of London, King's College, Strand, W.C. 2. 1923-27. 1934-36;
Hon. Sec. 1928-29;
Pres. 1930-31;
V.-P. 1932-33; 1937-
- 1925 Gay, Alfred D., F.C.S., M.S.C.I.
49, Thornlaw-road, West Norwood, S.E. 27.
- 1937 Gearey, Frederick Horace.
c/o Dodwell & Co., Ltd., 17, Canton Road, Shanghai, China.
- 1921 *Gilpin-Brown, Leslie George.
Rosemarie, Maenporth, Nr. Falmouth, Cornwall.
- 1937 Gimi, Jal Pheroze, B.A.
Empress Mills Road, Nagpur, C.P., India.
- 1904 Goadby, Sir Kenneth Weldon, K.B.E., M.R.C.S., L.R.C.P.
83, Harley-street, W. 1.
- 1928 Gomersall, Percy Phipps.
Grosmont, Byron-avenue, Lincoln.
- 1928 Goode, Edward Francis.
185, Little Collins-street, Melbourne, Australia.
- 1922 Gosling, George Walker.
c/o Messrs. Martin & Harris, Ltd., Sudama House, Wittet Road, Ballard Estate, Bombay, India.

Elected.

Service on
Council, etc.

- 1927 Graham, Charles H. Edger.
26, *Gordon-avenue, St. Albans, Christchurch, New Zealand.*
- 1933 Graham, David Henry, F.Z.S.
- 1937 Graham-Porter, Arthur.
21, *St. Martin's Road, Canterbury, Kent.*
- 1926 Grainger-Shackles, Alfred.
The Laboratory, Royal Infirmary, Sheffield.
- 1923 Gravelle, Philip O., F.R.P.S.
114, *Prospect-street, South Orange, New Jersey, U.S.A.*
- 1937 Gray, Ernest Alfred, M.R.C.V.S.
Veterinary Officer, East Anglian Institute of Agriculture, Chelmsford, Essex.
- 1933 Gregory, Puthenparampil Joseph, M.A. (Madras), Ph.D., F.L.S.
Puthenparampil, Edathua, Tiruvalla, S. India.
- 1936 Grigg, Frederick C.
Arundel House, Stanwell, Staines, Middx.
- 1935 Grimmo, Aubrey Edward Peter.
c/o Medical Laboratories, Shanghai Municipal Council, Shanghai.
- 1924 Gurr, George Thomas, F.C.S.
35, *High Drive, New Malden, Surrey.*
- 1912 Gurrin, Gerald Francis.
59, *Holborn-viaduct, E.C. 1.*
- 1923 Hagelstein, Robert.
165, *Cleveland-avenue, Mineola, New York, U.S.A.*
- 1931 Haggis, A. W., F.L.S.
16, *Danvers Street, Chelsea, S.W.3.*
- 1936 Hakim, Dara Rustomji, B.Sc., L.C.P.S., M.B.B.S.
Rackfad Clinic, 618, Dhobi Talao, Bombay, India.
- 1912 Hall, Rev. Charles A.
Clynder, Lansdowne-road, Worthing.
- 1920 Hall, T. D. Tuton.
4, *King-street South, Rochdale.*
- 1933 Hanna, G. Dallas, Ph.D.
Curator, Department of Paleontology, California Academy of Sciences, San Francisco, California, U.S.A.
- 1919 Harper, Capt. Raymond Sydney, M.R.C.S., L.R.C.P., R.A.M.C.
36, *First-avenue, Hove, Sussex.*
- 1930 Harper-Roberts, Herbert John.
34, *College-road North, Liverpool.*
- 1928 Harris, Alfred Ernest.
44, *Partridge-road, Roath, Cardiff.*
- 1905 Harris, Charles Poulett, M.D. (Lond.), M.R.C.S., L.R.C.P.
Merrow Down, Newlands-road, Rottingdean, Brighton.

Elected.

- 1934 Harry, Ralph Gordon, F.I.C., M.R.I.P.H.
183, *Cathedral-road, Cardiff.*
- 1925 Hartley, Isaac.
16, *Fern Bank, Nelson, Lancs.*
- 1934 Harwich, Alfred Ernest.
c/o Uganda Police Headquarters, Kampala, Uganda.
- 1937 Hayes, Frederick Ronald.
Professor of Zoology, Zoological Laboratory, Dalhousie University, Halifax, N.S., Canada.
- 1916 Hazeldine, Frederick James.
Barnfield, South Godstone, Surrey.
- 1938 Hegerty, John Donald.
A.S.P., Jerusalem Urban Division, Palestine Police, Jerusalem.
- 1927 Heller, Ernest.
Aurorastrasse 78, Zurich 7, Switzerland.
- 1931 Hendey, Norman Ingram, M.P.S., F.L.S.
15, *The Chase, Hillingdon, Middlesex.*
- 1891 Heron-Allen, Edward, F.R.S., F.G.S., F.Z.S., M.R.I.A., etc.,
Large Acres, Selsey Bill, Sussex.
- 1910 Hewlett, Richard Tanner, M.D., F.R.C.P., D.P.H., *Hon. Secretary.*
Director of Pathology, Pathological Department, Seamen's Hospital, Greenwich, S.E. 10, and 11, Crooms Hill, Greenwich, S.E. 10.
- 1904 *Hill, Cyril Francis, M.Inst.M.M., A.Inst.P., *Treasurer.*
Daresbury Hall, near Warrington.
- 1936 Hill, Edwin Valentine, M.Sc.
87, *North Hancock Street, Lexington, Mass., U.S.A.*
- 1881 *Hill, Joseph Alfred, F.L.S.
St. Bees, Northumberland-road, Leamington.
- 1929 Hind, Herbert Lloyd.
The Laboratory, 325, City Road, Manchester, 15.
- 1931 Hindle, Professor Edward, M.A., Sc.D., Ph.D.
Department of Zoology, The University, Glasgow, W.2.
- 1906 Hiscott, Thomas Henry, F.L.S.
7, *Lichfield Road, Kew, Surrey, and 5, Stone Buildings, Lincoln's Inn, W.C. 2.*
- 1933 Hocking, Frederick Denison Maurice, M.B., B.S., M.Sc., F.I.C.
St. Andrews, Perranporth, Cornwall.
- 1921 Holder, J. T.
114, *Pepys-road, S.E. 14.*
- 1934 Holmes, Herbert, F.C.S.
Helmsley, 192, Windsor Lane, Burnham, Bucks.

1936-
Cur. Slides 1934-1909-10; 1913;
1921-22
V.-P. 1911-12; 1914
1918-19;
Pres. 1910-171915-16; 1931;
Hon. Sec. 1932-1910-12;
Trans. 1913-

1933-35

1917-21; 1924-25
V.-P. 1922-23

Elected.

Service on
Council, etc.

- 1931 Holsinger, Edward Charles Talleyrand, B.Sc. (Lond.),
*Lecturer in Biology, Government Training College,
Colombo, Ceylon.*
- 1921 Holt, Alfred, F.C.S.
Hedgecroft, Stubbins-lane, Ramsbottom.
- 1934 Horning, Eric Stephen, M.A., D.Sc.
*Imperial Cancer Research Laboratories, 8-11, Queen-
square, London, W.C. 1.*
- 1921 Horton, William, M.Sc.
Homesefton, 223, Queen's-drive, Wavertree, Liverpool, 15.
- 1917 Howard, Henry J., F.L.S.
6, College-road, Norwich.
- 1930 Howden, Alfred Llewellyn.
Rosalyn, 10, Milnes-avenue, Thornes-road, Wakefield.
- 1918 Hughes, Owen Lloyd.
*The Council School, Trefnannay, Meiford, S.O., Mont-
gomeryshire.*
- 1927 Hugill, William, M.Met.
Langham House, Fields-road, Alsager.
- 1922 Hulls, Leonard G., F.C.S., etc.
Rax, Chidham, near Chichester, Sussex.
- 1929 Humphriss, Eric Lewis Enoch.
Penrhyn, 82, Linkstor Road, Woolton, Liverpool.
- 1921 Hunt, Reginald J. H.
Mitylene, Stanmore-road, Harrow Weald.
- 1933 Hunter, Robert Angus.
Sanatorium, Bridge of Weir, Renfrewshire.
- 1931 Hunwicke, Roderick Francis, B.Sc. (Lond.), A.I.C.
Salisbury Cottage, Hadley Highstone, Barnet.
- 1913 Hurrell, Harry Edward.
60, Albany-road, Great Yarmouth.
- 1937 Hussey, Rev. Christopher Rowden, M.A.
St. Mary's Vicarage, Shrubland Road, Haggerston, E.8.
- 1930 Inglesent, Harold.
*8, Sunny Brow-road, Archer Park, Middleton, Man-
chester.*
- 1933 *Insch, James.
18, Beechwood Avenue, Boscombe, Hants.
- 1922 Jackson, James Joseph.
Fern House, 10, Blake Hall-road, Wanstead, E. 11.
- 1923 Jackson, Joseph Taylor, M.Sc.
*Wesleyan Boys' High School, P.O. Box 165, Lagos,
West Africa.*

Elected.

- 1928 James, William McCully, M.D., F.A.C.P.
Box 567, Ancon, Canal Zone, Panama.
- 1925 Jefferies, F. C. B.
Brynmelyn, Winscombe, Somerset.
- 1931 Jelley, Edwin Ernest, D.Sc.(Lond.), F.I.C., F.R.P.S.
*Eastman Kodak Co., Kodak Park Works, Rochester,
N.Y., U.S.A.*
- 1931 Jenkins, Albert Edward.
135, Burns-avenue, Southall, Middlesex.
- 1922 Jennison, James.
Edale, Sandy Lodge-road, Moor Park, Rickmansworth.
- 1901 Johnson, Charles Harold, M.D., C.M., F.R.C.S.E.
*16, The Ridge, Canterbury, near Melbourne, Victoria,
Australia.*
- 1929 Johnston, John.
18, Mecklenburgh-square, W.C. 1.
- 1918 Jones, Sir Bertram Hyde, K.B.E.
The White House, Sanderstead Village, Surrey.
- 1937 Jones, Harry.
128, Raeburn Avenue, Eastham, Cheshire.
- 1910 Jones, William Llewellyn.
Feremina, St. Martin's, Guernsey, Channel Islands.
- 1910 Keeley, Frank J., B.S., F.M., *Member of Board of Trustees,
Academy of Natural Sciences of Philadelphia.
Box 25, Merion Station, Penna, U.S.A.*
- 1925 Kefalas, Andrew, M.A., M.B., Ch.B., F.S.S.
Oriel Chambers, 14, Water Street, Liverpool.
- 1937 Kenny, Percy Arthur Chambers.
Veterinary Research Laboratory, Khartoum, Sudan.
- 1918 Kidd, Robert Hicks.
Marlborough House, Newbury, Berks.
- 1927 Killick, Charles Rowe, M.B.
Tower Hill, Williton, Somerset.
- 1930 *Klein, Carl Adolphe.
*7, Queen Anne's-grove, Bush Hill-park, Enfield,
Middlesex.*
- 1936 Knight, Maxwell, F.Z.S., F.R.G.S.
38, Sloane Street, London, S.W.1.
- 1920 Knight-Hallowes, K. A., M.A. (Cantab.), A.R.S.M. (Lond.),
F.G.S., A.Inst.M.M., F.Inst.P., Mem.R.S.L.
Gillbank, Hawkshead, Ambleside, Westmorland.
- 1934 Kufferath, Hubert, Professor.
20, Rue Joseph II, Brussels.

1935-37 ;
V.-P. 1938

Elected.

Service on
Council, etc.

- 1931 Laden, John William.
1, *Glenmere-avenue, Mill Hill, N.W. 7.*
- 1932 Langer, Otto.
Woodlands-park, Blackbrook, Dorking, Surrey.
- 1887 Latham, Miss Vida Annette, M.D., D.D.S.
1644, *Morse-avenue, Roger's-park, Chicago, Ill., U.S.A.*
- 1928 Laws, Sydney Gibson.
The Veterinary Laboratory, Entebbe, Uganda, British East Africa.
- 1938 Lee, Christopher Darnley, A.R.San.I.
Research Department, The Royal Eastern Counties' Institution, Ltd., Colchester, Essex.
- 1936 Legg, William Ivor Lionel.
c/o Mansfield & Co., Ltd., Ocean Building, Singapore, S.S.
- 1932 Leurquin, Albert C. A., LL.D., D.C.L.
84, *Avenue Brugmann, Brussels, Belgium.*
- 1927 Lewis, Frederic Henry, I.S.O.
2, *Granville Court, Granville-road, Eastbourne.*
- 1932 Lewis, Frederic Thomas, A.M., M.D.
Professor of Comparative Anatomy, Harvard Medical School, Boston, Mass., U.S.A.
- 1931 Linfoot, Sydney, B.Sc. (Lond.).
The Laboratory, 42, Wimpole Street, London, W.1 and 40, Carlton Avenue, Harrow, Middlesex.
- 1919 Lissimore, Norman.
The Clinical Laboratory, 6, Victoria-avenue, Harrogate.
- 1926 Lohman, Kenneth E.
U.S. Geological Survey, Washington, D.C., U.S.A.
- 1927 Long, John A.
Mayhurst, Menston-in-Wharfedale, Leeds.
- 1937 Lord, James Allan.
11, *Gordon Street, Rawtenstall, Rossendale, Lancs.*
- 1932 Losch, Paul K., D.D.S.
371, *Lexington-street, Auburndale, Mass., U.S.A.*
- 1922 Lowe, Frederick Charles.
10, *Buchanan-road, Walsall.*
- 1921 Ludford, Reginald James, Ph.D., D.Sc., F.Z.S.
"Woodingdene," *The Ridgeway, Mill Hill, N.W.7.*
- 1936 McArthur, John Norrie, M.R.C.S., L.R.C.P.
Malaria Research Officer, c/o British North Borneo (Chartered) Co., Tambunan, via Jesselton, British North Borneo.
- 1926 McCartney, James Elvins, M.D., Ch.B., D.Sc.
147, *Burnt Ash Hill, S.E. 12.*

1922-24 ;
V.-P. 1925-26

1929-31 ; 1933-34

Elected.

Service on
Council, etc.

- 1929 McDonald, James Stenson.
Human Trypanosomiasis Institute, Entebbe, Uganda.
- 1937 McDougall, John T. M., M.B., B.S.
8, *Dunkeld Road, Bournemouth.*
- 1916 *McEwen, Alfred.
Craig Avel, Tarrytown-on-the-Hudson, New York, U.S.A.
- 1928 Mackinnon, Miss Doris Livingston, D.Sc., F.L.S.
*Professor of Zoology in the University of London,
King's College, Strand, W.C.2, and 44, St. Leonard's
Terrace, Chelsea, S.W.3.* 1930 31
- 1938 Maclean, George.
*Detective Inspector, Finger Print Bureau, City of
Glasgow Police, Glasgow.*
- 1925 MacLeod, Evan Greville.
Effingham House, Copthorne, Crawley, Sussex.
- 1936 McMiken, Thomas William.
*c/o Mrs. Peter Grant, Ben Lomond, Kingsthorpe,
Darling Downs, Queensland, Australia.*
- 1928 Malcolm, Robert Conacher, F.R.Met.Soc.
*Asst. Supt. Mathematical Inst. Office, Survey of India.
15, Wood-street, Calcutta, India.*
- 1909 Mapp, Charles Richard, B.Sc.
31, *Montpellier-terrace, Cheltenham.*
- 1931 Mar, Peter G., M.A., M.Sc., F.C.S.
*The Henry Lester Institute of Medical Research, Division
of Physiological Sciences, 1320 Avenue Road, Shanghai.*
- 1925 Mason, William Glanvill, F.B.O.A., F.N.A.O., F.I.O.
Bernvale, Maidstone-road, Chatham, Kent.
- 1930 Mather, Wilfred, Assoc. M.C.T., F.I.C.
*Deepdene, Audenshaw - road, Audenshaw, near
Manchester.*
- 1921 Mathews, Harold J. C., F.C.S.
Fairhill, Reedley, near Burnley, Lancs.
- 1929 Matthews, George Pengwerne, D.M.D., L.R.C.P. (Ed.),
L.R.C.S. (Ed.), L.R.F.P. & S., M.D., C.M.
*c/o The National Bank of Australasia, Broadway,
Sydney, New South Wales, Australia.*
- 1934 Matthews, J. Hugoc, M.R.C.S., L.R.C.P.
Almorah, Totnes Road, Paignton, S. Devon.
- 1933 Matthews, Stephen John.
60, *York Road, Cheam, Surrey.*
- 1922 Maxwell, Edward Kelly, B.A.
75, *Bushwood-road, Kew, Surrey.* 1933-36
- 1929 Medina, Professor Francisco, M.C., M.S., M.B.
Ave. Condesa 635, Col. del Valle, Mexico, D.F.
- 1879 *Mercer, A. Clifford, M.D.
324, *Montgomery-street, Syracuse, N.Y., U.S.A.*

Elected.

- 1899 Merlin, Augustus Alfred Cornwallis Eliot.
107, *Argyle-road, West Ealing, W.* 13.
- 1924 Millar, William G., M.B., Ch.B.
Pathology Department, University of Edinburgh.
- 1895 Millard, Edgar James, F.C.S.
35-42, *Charlotte-street, E.C.* 2.
- 1912 Mills, Frederick William, F.L.S.
Woodford Hall, Milton Damerel, N. Devon.
- 1925 Mirza, M. B., B.Sc.
Chairman, Dept. of Zoology, Muslim University, Aligarh, U.P., India.
- 1905 Moffat, Eliczar.
75, *High-street, Chatham.*
- 1937 Moll, Jan Adolph Maria van, K.I.V.I., A.I.S.E.
Verena, Bramley Road, Nonsuch Park, Cheam, Surrey.
- 1938 Moore, Glenn S., M.D., B.Sc.
59, *East Madison Street, Chicago, Ill., U.S.A.*
- 1938 Moore, Harry, D.Sc., A.R.C.S., F.Inst.P.
Croft House, Archway Road, Huxton, Near Liverpool.
- 1929 More, Andrew, I.S.O., A.R.C.S., A.R.T.C., F.I.C.
Andorra, Midway, Walton-on-Thames. 1932-34; 1936-
- 1932 Morrish, William John, M.D., M.R.C.P., D.P.H.
32, *Thrale-road, Streatham, S.W.* 16.
- 1915 Mosley, Frederick Ormrod.
Pinnfold, Church-road, Cowley, Middlesex, and Pathological Laboratory, The Nurseries, Uxbridge, Middlesex.
- 1925 Mottram, James Cecil. 1927-23
Radium Institute, Riding House-street, W. 1.
- 1938 Munshi, Dara Mervanji, B.Sc.
Professor of Biology, St. Xavier's College, Cruikshank Road, Fort, Bombay, India.
- 1900 Murphy, Albert John, F.C.S.
2, *Dorset-square, N.W.* 1, and *Wheathampstead House, Wheathampstead, Herts.*
- 1919 Murray, James Alexander, M.D., F.R.S.
2, *Belgrave Mansions, Belgrave Gardens, London, N.W.* 8. 1920; 1938-
Hon. Sec. 1921-25;
Pres. 1926-27;
V.-P. 1928-29;
1936-37
- 1937 Musgrave, Anthony John, B.Sc., A.R.C.S., D.I.C.
21, *Loveday Road, London, W.* 13.
- 1930 Myers, Frank J.
15, *S. Cornwall-place, Ventnor, N.J., U.S.A.*
- 1936 Naithani, Shambhoo Prasad, M.Sc.
- 1914 Nall, George Herbert.
Ayot Lodge, Ayot St. Peter, Welwyn, Herts.

Elected.

- 1935 Nandi, Hirendra Kumar, M.Sc. (Cal.), Ph.D. (Lond.), F.I.S.
Bose Institute, 93/1, Upper Circular Road, Calcutta.
- 1928 Nath, Vishwa, M.Sc., Ph.D.
Lecturer in Zoology, Government College, Lahore, India.
- 1926 Needham, George H., M.Sc.
2006, 10th-avenue, San Francisco, California, U.S.A.
- 1933 Newman, Arthur Samuel, F.R.P.S. 1936 -
25, Hornsey-lane, London, N. 6.
- 1930 Newman, Ivor Vickery, M.Sc.
*Department of Biology, Victoria University College,
Wellington, New Zealand.*
- 1923 Newton, Charles Arthur.
4, Lansdowne-road, Seven Kings, Essex.
- 1937 Newton, Warren Zenis.
212, North Orange Street, Glendale, Calif., U.S.A.
- 1935 Nicholls, Frederick Thomas.
Police Laboratory, Central Police Office, Bristol.
- 1924 Nigam, Mahadeva Prasad, M.Sc.
*Professor of Biology, Lucknow Christian College,
Lucknow, India.*
- 1911 Noad, Lewis.
7, King's Bench-walk, Temple, E.C.
- 1899 Norman, Albert, L.R.C.P. and L.R.C.S. Edin.
35, Coleherne-road, Earl's Court, S.W. 10.
- 1930 Novis, Albert Grabham, M.P.S.
Vandetta, 37, Hova Villas, Hove, Sussex.
- 1925 Nurnberg, Roy Charles Albin.
*c/o Bausch & Lomb Optical Co., Export Department,
Rochester, N.Y., U.S.A.*
- 1920 Oakden, Charles H.
30, Meadow-road, Shortlands, Kent.
- 1937 Odam, Charles Leslie, M.A., M.R.C.S., L.R.C.P.
21, Adelaide Road, Brockley, S.E.A.
- 1927 Ogg, Alexander, B.Sc., Ph.D.
*Professor of Physics, University of Cape Town, Cape
Town, South Africa.*
- 1923 Owen, Charles Todd.
The Logs, 12, East Heath Road, Hampstead, N.W.3.
- 1900 Oxbrow, Alfred William.
1, Brigg-street, Haymarket, Norwich.
- 1937 Palmer, Chetwynd.
"Somerlea," 69, Kilnorie Road, Forest Hill, S.E.23.
- 1933 Palmer, Kenneth Lewis, F.R.E.S.
Meadowlea, Gobowen, Salop.

Elected.

- 1919 Parish, Rev. Herald.
2, Acton Road, Esh Winning, Co. Durham.
- 1928 Parr, Walter James.
17, Bokhara-road, Caulfield, S.E. 8, Victoria,
Australia.
- 1898 Payne, Captain Arthur E. T.
*Physiological Laboratory, University of Melbourne,
Victoria, and Scotsburn, Toorak, Melbourne, Victoria.*
- 1884 *Peek, The Honourable Lady.
Hambury Fort House, Honiton.
- 1934 Pentland, Albert.
3, Ebers Road, Mapperley Park, Nottingham.
- 1931 Pickering, John W., D.Sc.
*Lecturer on Hæmatology, University of London, King's
College, W.C.2, and Sundridge, Russell Hill, Purley,
Surrey.*
- 1937 Pijper, Adrianus, M.D., D.Sc.
57, Celliers Street, Pretoria, South Africa.
- 1925 Pilditch, F. W.
66, Tetley-road, Hall Green, Birmingham.
- 1907 Pledge, John Harry.
72, Nibthwaite-road, Harrow, Middlesex.
- 1926 Pledger, Robert Howland, B.Sc.
Ewell Castle, Surrey.
- 1902 Poser, Max.
16, Vick Park B., Rochester, N.Y., U.S.A., and c/o
Bausch & Lomb, St. Paul-street, Rochester, N.Y.,
U.S.A.
- 1923 Potter, Herbert.
387, Moseley-road, Birmingham, 12.
- 1892 Pound, Charles Joseph.
Steven Street, Yeronga, Queensland, Australia.
- 1937 Price, George, P.C.
74, Florence Avenue, Balby, Doncaster.
- 1933 Price, Herbert.
Woodside, Bradshaw-road, Bolton, Lancs.
- 1931 Prideaux-Brune, Captain Fulke Knatchbull.
Highfield, Dallington, Sussex.
- 1936 Purdy, Wilfred John, M.B.
22, Selvage Lane, Mill Hill, N.W.7.
- 1926 Ramanujam, S. G. Manavala, M.A., Ph.D., D.I.C., F.Z.S.
*Professor of Zoology, Presidency College, Triplicane,
Madras, South India.*
- 1938 Ramsden, David Cyril, L.D.S.
257, Hyde Park Road, Leeds, 6.

1929-31; 1935-

1913

Elected.

Service on
Council, etc.

- 1928 Ramsden, Lt.-Col. Josslyn Vere, *C.M.G.*, *D.S.O.*, *M.A.*,
F.R.G.S., *F.G.S.*
Offwell House, Offwell, Honiton, Devon.
- 1896 Ranken, Charles, *F.C.S.*
11, Stockton-road, Sunderland.
- 1937 Ransom, Charles Gray.
Litterer Laboratories, 501, Doctors Building, Nashville,
Tenn., U.S.A.
- 1928 Rao, L. Narayana, *M.Sc.*
Assistant Professor of Botany, Central College, Banga-
lore, South India.
- 1921 Rau, A. Subba, *D.Sc.*, *B.A.*
Department of Physiology, Medical College, Mysore,
South India.
- 1930 Reddie, John Alexander, *F.I.C.*
Derwent Lodge, Portinscale, Keswick, Cumberland.
- 1910 Reid, Alfred, *M.B.*, *D.P.H.*, *B.Hy.* Durh., *M.R.C.S. Eng.*,
L.R.C.P., *Government Medical Officer.*
Batang Padang Estate, Tapah, Perak, Federated Malay
States, and Royal Empire Society, Northumberland-
avenue, W.C. 2.
- 1937 Reilly, George Buckham, *A.R.San.I.*
"Kolar," 40, Abbeyfield Road, Sheffield, 4.
- 1930 Reyersbach, Cecil Douglas.
313, High Holborn, London, W.C. 1.
- 1899 Rheinberg, Julius, *F.Inst.P.*
Inglennook, 12, Brondesbury-park, N.W. 6.
- 1928 Rhodes, Henry.
Melbourne Lea, Whitegate, Halifax, Yorks.
- 1927 Rhodes, Herbert William.
7, Ashburn-place, Ilkley, Yorks.
- 1924 Rhys-Davies, William, *F.I.C.*
41, Peel Place, Bradford, Yorks.
- 1893 Richardson, Frederic William, *F.I.C.*, *F.C.S.*, *County Analyst.*
Bradford.
30, Queen's Park-avenue, Bournemouth.
- 1938 Richardson, James, *F.R.E.S.*
104, Bothwell Street, Glasgow, C.2.
- 1926 Rigby, John Tomlinson.
21, Hereford-road, Southport.
- 1929 Rivers-Cole, Harold Robert, *L.D.S.*, *R.C.S.Eng.*, *F.Z.S.*
108, Wallace Avenue, West Worthing.
- 1937 Roberts, Robert, *M.P.S.*
3, Cheap Street, Frome, Somerset.
- 1934 Roberts, Thomas Allen, *Det.-Inspector.*
Surrey Constabulary Headquarters, Guildford, Surrey.

1905-07 ; 1909-14 ;
1920-21 ; 1923-30 ;
1933-35
V.-P. 1915 ; 1931-32

Elected.

Service on
Council, etc.
1926-28; 1933-35
V.-P. 1929-30

- 1921 Robins, Edmund Arthur, F.L.S.
Gorran, Cassiobury Park-avenue, Watford, Herts.
- 1910 *Robins, Herbert George, F.R.G.S.
Toms Farms, Wankie, S. Rhodesia, South Africa.
- 1935 Robinson, Joseph Frederick,
*Biology Master, King's College, Budo, Uganda Pro-
tectorate.*
- 1917 *Robinson, Miss Nancy M.
*The Bridge House, Dormans Park, East Grinstead,
Sussex.*
- 1927 Robinson, Sydney Harold.
The Homestead, York-avenue, Lincoln.
- 1929 Roger, Henry.
Sandy Hook, Connecticut, U.S.A.
- 1930 Rohr, Moritz von, Ph.D., M.D. h.c. Jenae.
*Emeritus Professor of Optics, University of Jena,
5^{II}, Moltkestrasse, Jena, Germany.*
- 1921 Room, H. W. Reginald.
Grey Russet, Edward-road, Bromley, Kent.
- 1937 Rose, John Harold Cameron.
"Berwyn," Hastings, Christ Church, Barbados, B.W.I.
- 1911 Ross, John Pilkethly, M.P.S.
P.O. Box 228, Bombay, India.
- 1931 Ross, Robert, M.A.
*British Consulate General, 360, N. Michigan-avenue,
Chicago, Ill., U.S.A., and c/o Foreign Office, London.*
- 1938 Ross, Robert, B.A. (Cantab).
*British Museum (Natural History), Cromwell Road,
London, S.W.7.*
- 1932 Row, R. Madhava, M.Sc.(Lond.), F.L.S.
*Asst. Rice Research Officer, Rice Research Station,
Hmawbi, Burma.*
- 1918 Rowley, Frank, M.I.M.M.
The Bouldnor, Yarmouth, Isle of Wight.
- 1897 Rowley, Frederick Richard.
7, Victoria Park-road, Exeter.
- 1917 Ryland, Lieut.-Colonel Alfred W.
30, Higher Bank-road, Fulwood, Preston.
- 1922 Saguchi, Professor Sakae.
Kanazawa Medical College, Kanazawa, Japan.
- 1918 Salmon, Walter.
*Sandiway, 66, Goldieslie-road, Wylde Green, Bir-
mingham.*
- 1932 Sartory, Peter Karel.
*34, Elm-grove, Harrow Garden Village, Rayner's Lane,
Harrow, Middlesex.*

Elected.

Service on
Council, etc.

- 1909 Saxton, Thomas R., Assoc.M.Inst.C.E.
43, *East Bank, Stamford Hill, N.* 16.
- 1928 Sayeeduddin, Mohammed, M.A., B.Sc.
*Professor of Botany, Osmania University, P.O. Lalla-
guda, Hyderabad-Deccan, India.*
- 1913 Scott, Wm., F.R.C.V.S.
Frian House, Bridgwater.
- 1900 *Scourfield, David J., I.S.O., F.L.S., F.Z.S.
6, *Chadwick-road, Leytonstone, E.* 11.
- 1917 Sears, R. S. W.
1, *Lisson-grove, Marylebone, N.W.* 1.
- 1935 Semmens, Cecil Samuel, A.R.P.S.
4, *Craneswater Park, Southall, Middlesex.*
- 1924 Setna, Sam B., M.Sc., Ph.D.
*Pillo Minar, 15, Walton-road, Appolo Reclamation,
Bombay, India.*
- 1929 Sheldrake, Reginald Alfred, M.P.S.
41-43, *Appleton Gate, Newark-on-Trent.*
- 1885 *Shelley, Major A. D. G., R.E. (retired).
Hitherbury, Portsmouth-road, Guildford.
- 1909 Sheppard, Edward James.
137, *Kennington-road, Lambeth, S.E.* 11.
- 1909 Sidwell, Clarence J. H.
46, *Ashbourne-grove, East Dulwich, S.E.* 22.
- 1912 Simpson, Norman Douglas, M.A., F.L.S.
Maesbury, Cavendish-road, Bournemouth, Hants.
- 1924 Smiles, John, A.R.C.S., Hon. Secretary.
22, *Coniston-road, Muswell Hill, N.* 10.
- 1925 Smith, Charles A.
6, *Poynings Way, Woodside Park, Finchley, N.* 12.
- 1917 Smith, Joseph, F.S.A.A.
Kenwyn, 90, Kenwyn-road, Ellacombe, Torquay
- 1930 Smith, Robert Low, F.C.S.
70, *Grove Park-road, Mottingham, S.E.* 9.
- 1897 Soar, Charles David, F.L.S.
The Crossways, Hertford Heath, Herts.
- 1934 Spector, Benjamin, M.D.
*Professor of Anatomy, Tufts College Medical School,
416, Huntington-avenue, Boston, Mass., U.S.A.*
- 1937 Stach, Leopold William, M.Sc.
78, *Herbert Street, Albert Park, S.C.6, Victoria, Aus-
tralia.*
- 1934 Stern, Miss Ruby Olive, M.D., M.R.C.S., L.R.C.P.
72, *New Cavendish Street, London, W.* 1.
- 1909 Stewart, Thomas S., M.D.
The Union League Club, Philadelphia, Pa., U.S.A.

1908-13 ; 1924-25 ;
1930-
V.-P. 1914-15 ;
1921-22 ;
Hon. Sec. 1916-20

1916-22 ; 1928-33
Cur. Slides 1914-35
V.-P. 1923-24

1932-33
Hon. Sec. 1934-

1915-18

Service on
Council, etc.

Elected.

- 1938 Stracey, Bernard, M.B., Ch.D.
Chalet Dunbeg, Diemtigen, Simmenthal, Switzerland.
- 1914 Strachan, James, F.Inst.P.
The Orchard, Hawk Green, Meopham, Kent.
- 1923 Stream, Ernest John, M.A. (Cantab.), F.L.S.
Burnham, Grosvenor-road, Orpington, Kent.
- 1934 Subramaniam, M. K., B.A.
University Zoological Laboratory, Chepauk Post, Madras, South India.
- 1906 Swift, Mansell James.
81, Tottenham Court-road, W. 1.
- 1935 Taffs, Harold John.
"The Cloisters," Carlyon Corner, Yeading Lane, Hayes, Middlesex.
- 1925 Talmage, Sterling Booth, M.Sc., Ph.D.
Professor of Geology, New Mexico School of Mines, Socorro, New Mexico, U.S.A.
- 1932 Tanner, Frederick John.
13, King's Park-road, Bournemouth.
- 1900 Taverner, Henry.
Lyncroft, 79, Carlisle Road, Eastbourne.
- 1934 Thalmann, Hans E., Ph.D.
N. V. Nederlandsche Koloniale Petroleum Maatschappij, Palembang, Sumatra.
- 1933 Thompson, Keith S., M.R.C.S., L.R.C.P.
Department of Pathology, The University, Edmund-street, Birmingham.
- 1938 Thornton, Walter Wilson.
Chief Superintendent, Lancashire Constabulary, County Police Office, Preston, Lancs.
- 1929 Thüringer, Joseph Mario, M.D.
School of Medicine, University of Oklahoma, Oklahoma City, Oklahoma, U.S.A.
- 1912 Tierney, Clarence, D.Sc., F.L.S., Secretary.
Coulsdon, Surrey, and Athenæum Club, S.W.1.
- 1923 Titchener, George R.
Yewnis, Lane End Road, Bembridge, Isle of Wight.
- 1926 Titchener, J. B.
Hatherwood, Manor Way, Beckenham, Kent.
- 1936 Tither, Reginald.
101, School Road, Stretford, Manchester.
- 1938 Todd, Charles Stephen.
Brambledean, 134, Gordon Road, Camberley, Surrey.
- 1925 Toorkey, Dinshaw Rustumji, M.A., B.Sc.
133, Prendergast-road, Secunderabad, Deccan, India.

1921-22 : 1925,
V.-P. 1923-24 ;
Sec. 1926-
Libr. 1929-

Elected.

- 1925 Troughton, Henry George.
5, Stone Buildings, Lincoln's Inn, W.C. 2.
- 1932 Tucker, Quincy C., C.Ph.M., U.S.N.
*U.S.P.H.S. Laboratory, 14th Avenue & Lake Street,
San Francisco, California, U.S.A.*
- 1935 Unsworth, John.
3, Elder Grove, New Moston, Manchester.
- 1934 Verleyen, E. J. B.
Leopold Kraag, 24, Antwerp.
- 1913 Verrall, Frederick H., B.A., LL.B.
The Hollies, Worthing, Sussex.
- 1926 Vickers, A. Eric J., M.Sc., Ph.D. (Lond.), F.C.S., F.I.C.
Hazeldene, Junction-road, Norton-on-Tees, Co. Durham.
- 1937 Voigt, Manfred, E.P.Z.
Cathay Mansions, Shanghai, China.
- 1928 Wagstaffe, Reginald.
Municipal Museum, Vernon Park, Stockport.
- 1936 Walker, Ross Bennett, B.Sc.
*c/o Powell and Hohn, 99, Quebec Street, Guelph, Ontario,
Canada.*
- 1923 Wallis, Thomas Edward, B.Sc., F.I.C., Ph.C.
21, Sunbury-avenue, Mill Hill, N.W. 7.
- 1909 Walter, Rev. Frederick William.
The Grange, Worstead, Norwich.
- 1929 Walton, Robert, F.C.S.
*Alexandria Water Co., Rond Point Laboratory,
Alexandria, Egypt.*
- 1936 Warburton, John Wilson.
Moorfield, Clayton Road, Lidget Green, Bradford.
- 1929 Warton, William Shakespeare.
35, Doneraile-street, S.W. 6.
- 1919 Watkinson, Harry.
Westwoods, Welholme-road, Grimsby.
- 1932 Weatherford, Harold Lorraine, M.A., Ph.D.
*Asst. Professor of Histology, Harvard Medical School,
240, Longwood-avenue, Boston, Mass., U.S.A.*
- 1912 Webb, Wilfred Mark, F.L.S.
The Hermitage, Hanwell, W. 7.
- 1927 Welch, Archibald Parker.
- 1924 Welch, Frank Victor.
26, Dallas-road, Hendon, N.W. 4.
- 1934 Weston, Edmund John, Captain.
Anatomy Department, King's College, Strand, W.C.2.

Service on
Council, etc.

Elected.

- 1928 Wetzel, Reinhard A., B.S.
218, *Tecumseh-avenue, Mount Vernon, N.Y., U.S.A.*
- 1919 Whipp, James Ewart, M.P.S., F.C.S.
3, *Snowdon View, High-street, Prestatyn, N. Wales.*
- 1933 Whitfield, Frank G. S.
48, *Ovington Street, London, S.W.3.*
- 1920 Whitfield, Herbert Charles.
6, *Kassala-road, Battersea Park, S.W. 11.*
- 1898 *Whittaker, Oscar, F.R.E.S.
Rivington, Teignmouth-road, Torquay.
- 1931 Wiedling, Maximilian.
20, *Mortimer-street, London, W. 1.*
- 1910 *Wilding, Percy P.
Baragh House, Priory-lane, Penwortham, Preston, Lancs.
- 1921 Wildman, J. T. R.
36, *Etherley-road, South Tottenham, N. 15.*
- 1936 Williams, Howel Griff.
22, *Craven Terrace, Lancaster Gate, W.2.*
- 1922 Williamson, William, F.R.S.E., F.L.S.
47, *St. Alban's Road, Edinburgh, 9.*
- 1923 Woodger, Arthur George.
530, *Great Western-road, Glasgow.*
- 1936 Woutersz, Clair Adrian, M.V.I., F.R.A.I.
" *Middelburg,*" *Mount Lavinia, Ceylon.*
- 1889 Wright, Charles Henry.
Kew Cottage, Townsend, Seaton, S. Devon.
- 1925 Wright, Rev. Frederick James, M.B.A.A.
17, *Ransom Road, Erdington, Birmingham.*
- 1921 Wrighton, Harold, B.Met.
21, *Archery-road, Eltham, S.E. 9.*
- 1919 Wycherley, Sydney R.
Windyridge, Woodhouse Lane, Uplyme, Lyme Regis, Dorset.
- 1928 Yarwood, Albert Reginald.
- 1890 *Youdale, William Henry.
- 1933 Young, Herbert John.
66, *Wandle-road, Morden, Surrey.*

1924-26 ; 1932-33 ;
1937-

1938-

HONORARY FELLOWS.

Elected.

- 1879 Balbiani, E. G.
Paris.
- 1929 Chapman, Frederick, A.L.S., F.G.S., Hon. F.R.S. Sth. Australia,
Melbourne, Victoria, Australia.
- 1938 Cushman, Joseph Augustine, Sc.D. (Hon.) Harvard.
Sharon, Mass., U.S.A.
- 1930 Farmer, Prof. Sir John Bretland, M.A., D.Sc., LL.D., F.R.S.
Bath.
- 1931 Fujii, Prof. K.
Tokyo.
- 1933 Hadfield, Sir Robert A., Bart., D.Sc., F.R.S., F.Inst.P.
London.
- 1905 Jennings, H. S.
Baltimore.
- 1934 Küster, Professor Ernst.
Giessen University, Germany.
- 1912 Penard, Dr. Eugene.
2, Rue Töpffer, Geneva.
- 1929 Rhumbler, Dr. Ludwig.
Münden.
- 1931 Rosenberg, Prof. Otto.
Stockholm.
- 1905 Wilson, Prof. Edmund Beecher.
New York.
- 1929 Winiwarter, Prof. Hans de.
University of Liège, Belgium.
- 1905 Wood, R. W.
Baltimore.

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*SIR RICHARD OWEN, <i>K.C.B.</i> , D.C.L., M.D., LL.D., F.R.S.	1840-1
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*THOMAS BELL, F.R.S.	1844-5
*JAMES SCOTT BOWERBANK, LL.D., F.R.S.	1846-7
*GEORGE BUSK, F.R.S.	1848-9
*ARTHUR FARRE, M.D., F.R.S.	1850-1
*GEORGE JACKSON, M.R.C.S.	1852-3
*WILLIAM BENJAMIN CARPENTER, <i>C.B.</i> , M.D., LL.D., F.R.S.	1854-5
*GEORGE SHADBOLT	1856-7
*EDWIN LANKESTER, M.D., LL.D., F.R.S.	1858-9
*JOHN THOMAS QUEKETT, F.R.S.	1860
*ROBERT JAMES FARRANTS, F.R.C.S.	1861-2
*CHARLES BROOKE, M.A., F.R.S.	1863-4
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*REV. JOSEPH BANCROFT READE, M.A., F.R.S.	1869-70
*WILLIAM KITCHEN PARKER, F.R.S.	1871-2
*CHARLES BROOKE, M.A., F.R.S.	1873-4
*HENRY CLIFTON SORBY, LL.D., F.R.S.	1875-6-7
*HENRY JAMES SLACK, F.G.S.	1878
*LIONEL S. BEALE, M.B., F.R.C.P., F.R.S.	1879-80
*PETER MARTIN DUNCAN, M.B., F.R.S.	1881-2-3
*REV. WILLIAM HENRY DALLINGER, M.A., LL.D., F.R.S.	1884-5-6-7
*CHARLES THOMAS HUDSON, M.A., LL.D.(Cantab.), F.R.S.	1888-9-90
*ROBERT BRAITHWAITE, M.D., M.R.C.S.	1891-2
*ALBERT D. MICHAEL, F.L.S.	1893-4-5-6
*EDWARD MILLES NELSON	1897-8-9
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*DUKINFIELD HENRY SCOTT, M.A., Ph.D., LL.D., F.R.S., F.L.S.	1904-5-6
*THE RIGHT HON. LORD AVEBURY, P.C., D.C.L., LL.D., F.R.S., etc.	1907-8
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R. S. CLAY, B.A., D.Sc., F.Inst.P.	1936-37

* Deceased.

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CATALOGUE OF THE PRINTED BOOKS AND PAMPHLETS IN THE LIBRARY OF THE ROYAL MICROSCOPICAL SOCIETY. 1929. vii + 177 pp. Price 3s. 6d. (To Fellows, 2s. 6d.); postage 3d.

EXPERIMENTAL STUDIES IN DIFFRACTION. By F. W. Shurlock. Parts I-IV, complete. *Ex Journ. Roy. Micr. Soc.*, Vol. LI, 1931. 33 pp., 10 plates, 4 text-figs. Price 5s. post free.

THE TECHNIQUE OF MOUNTING DIATOM AND OTHER TYPE SLIDES. By Professor Don Ernesto Caballero y Bellido. *Ex Journ. Roy. Micr. Soc.*, Vol. XLVII, 1927. 20 pp., 4 plates, 19 text-figs. Price 2s. 6d. post free.

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JOURNAL
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MARCH, 1938.

TRANSACTIONS OF THE SOCIETY.

PRESIDENTIAL ADDRESS.

I.—A REVIEW OF THE MECHANICAL IMPROVEMENTS OF 681
MICROSCOPES IN THE LAST FORTY YEARS.

BY REGINALD S. CLAY, B.A., D.Sc., F.Inst.P.

(*Delivered January 19th, 1938.*)

THIRTY TEXT-FIGURES.

MY first grateful task is to express to you my great appreciation of the honour you have done me in electing me as your President for a second year. The President is often, and certainly in my case, little more than a figure-head, but when a society has so efficient a Secretary to carry out the real work of the society as we have in Dr. Tierney, I am sure you will agree that the best policy for the President is to imitate the House of Peers in *Iolanthe*—which “did nothing in particular and did it very well.” His chief task is to deliver an address; to my great regret, last year I was unable even to do as I had intended in this, and through illness had to defer the greater part of it, namely the history of the mechanical development of the microscope.

In going through the old volumes of the Journal of the Society, I found that in 1899 your President, Mr. Nelson, had given three papers on the histories of the microscope,¹ of the coarse adjustment,² and of the fine adjustment.³ I had at first thought I would give a brief résumé of these papers and then continue with the histories up to the present time. I find, however, that there is so much to say on the developments of the last forty years that I cannot afford to deal with the earlier times, and I must refer any who may be interested in them to Nelson's papers.

In considering the changes that have occurred in the period with which

I am dealing, the first and very significant change is in the user. Up to that time microscopes had largely been designed for and sold to amateurs, but there was now springing up a large demand for microscopes for students in technical and medical schools and in the universities. In Germany, where the schools provided all students with their apparatus and where this movement had begun somewhat earlier than here, orders were placed for microscopes in large numbers. The microscopes were required only for low-power work and had to be much cheaper than the ordinary English model. The foreign firms had therefore developed the "Continental" microscope with the fine adjustment slide at the back of the stage and had to a large extent developed the manufacture on mass-production lines. Thus when the demand arose in England for student's microscopes, this form of microscope became the standard microscope for our students also. Its popularity was no doubt accentuated by the obsession that existed at that time for anything German, which must, it was supposed, necessarily be better than the corresponding English one. The demand which was thus fostered for the "Continental" microscope forced practically all our makers to list and make it—often against their better judgment. The placement of the slide so far from the body and the actuation of the slide by a direct-acting screw instead of by the long lever of Ross or Powell was a decided retrograde step. Any small give in the slide, which might not matter if the slide had been close to the body, becomes greatly magnified when that slide is several inches away; also the leverage of the weight of the body and coarse adjustment will tend to make the motion irregular and to produce excessive wear. Then, as Nelson points out,⁴ "a direct-acting screw fine adjustment (other than a differential), however well constructed, is quite incapable of fully developing the image given by an oil-immersion apochromatic with a large optical index." These imperfections of this model are now universally recognized and it has, I think we may say, been finally abandoned as a standard form.

The second and the outstanding change in the period with which I am dealing has been the change over from hand-production—in which one man carried through almost the whole making of the instrument, from the filing of the castings (except for a small amount of milling and turning of the small parts, which was sometimes done as a separate branch) to the final fitting—to the present-day machine-made instrument. Even after the cheap forms to which I have alluded above were being produced by machines, it was still considered necessary that the better-class instruments should be made by hand. It was due to the experience of the war, when, with a nucleus of skilled men, women and girls were able to make such things as prism binoculars, gun-sights, range-finders, aeroplane cameras, gauges, etc., to an order of accuracy that had never before been attained, that manufacturers learnt how, with suitable designing, instruments could be made in quantities by semi-skilled labour with the aid of precision machinery more perfectly than by the old skilled mechanic.

Microscopes thus made to gauge were necessarily interchangeable in a way that had not been possible with the older methods of production ; thus not only can alterations and additions easily be made to a microscope, but some firms have evolved a simple and comparatively inexpensive stand to which afterwards can be added such fittings as a centring substage, mechanical stage, binocular body, etc. Such an instrument is the Watson "Service" model (fig. 15), introduced in 1922,⁵ which can be bought with a plain understage carrier, two objectives, and one eyepiece, and to which can be added such items as iris diaphragm, double nosepiece, compound substage, mechanical stage, as and when required. Although I am afraid it is most unlikely, I should like to have seen this practice of arranging for the possibility of later additions to an original simple stand followed by all makers ; there must be students who would like to be able to buy their own instruments, but who cannot afford an expensive instrument at the beginning of their careers and would yet like to feel that as they pass on to more exacting work, needing higher powers, they will be able to have added the necessary substage, etc., to their instrument without having to exchange the whole instrument for a new one. It would be an added inducement to a student, who at first only uses low powers, say a two-thirds and a sixth, to purchase his own instrument instead of relying on the one supplied by the school, if he could thus supplement it from time to time, with the added advantage of the use of the instrument in the evenings and during vacations. By an extension of the principle of interchangeability, to which I refer later, it might even be perhaps possible to omit the fine adjustment in the first instance by substituting a dummy block for the fine adjustment slide (assuming that the fine adjustment slide could be made and added as a separate unit).

THE GENERAL DESIGN OF THE MICROSCOPE.

At the beginning of my period the chief English makers were Ross, Powell, Beck, Swift, Watson, Baker, who all were making good instruments. The fit and finish and the workmanship were all excellent, but their cost was very high. As already pointed out, the instruments were hand-finished and made either one at a time or at the most in small batches.

There were two forms of stand, that of Ross and Powell, where the body was screwed at right angles into an arm mounted on the top of the coarse adjustment bar, and those using the "Lister" limb. This limb, which is bent round the stage to carry at one end the coarse and fine adjustment slides and at the other the substage and mirror, was designed by Joseph Jackson Lister, father of Lord Lister. J. J. Lister, it will be remembered, was also the author in 1830 of the method of correcting the spherical aberration of the objective by superposing two achromatic lenses and adjusting their distance apart until the negative aberration of the one balanced the positive aberration of the other, which has since been the basis of the con-

struction of the low-power objective. The limb is often called the " Jackson " limb, but, as Nelson pointed out,⁶ the limb was made by Tulley in a microscope completed on May 30th, 1826, " From original drawings by my friend J. J. Lister, Esq." Mr. Nelson continues : " The question now arises, What was Jackson's invention ? It consisted in the ploughing of the slide which carried the body and that which carried the substage, in one plane, and out of one solid piece of metal. . . . You will notice that Jackson's improvements were far later in point of time than those of Mr. Lister, for if you will examine Mr. James Smith's microscope that was made to the order of the Microscopical Society of London and delivered in November, 1841,⁷ you will see that it has the Lister limb, but neither the Jackson ploughed groove nor the Jackson double pillar."

In 1851 Smith and Beck ploughed the Jackson grooves for the body and substage in the one operation for a microscope made for the Great Exhibition.

Thus the Lister limb and the Jackson ploughed groove for the slides were introduced in 1841 and 1851 respectively, but the real importance of these features was not appreciated because the necessity for the rigidity which they made possible had not yet arisen. Other makers occasionally used the Lister limb. Powell used it for his " Iron " microscope, as pointed out by Nelson,⁸ and Ross also used it,⁹ but in neither of these was the fine adjustment slide carried on this limb—in the Powell there was no fine adjustment and the Ross had the nose-piece screw, surely the worst fine adjustment ever invented.

Somewhere in the 'eighties Ross brought out first a Ross-Jackson and later a Ross-Zentmeyer microscope, both of which had the Lister limb fitted with the two slides for the coarse and fine adjustments respectively, the latter worked by a long lever and screw.

It is curious that Dallinger strongly condemned the idea of carrying the whole weight of the body on the fine adjustment, he says : ¹⁰ " This form could not—as it did not—long prevail." *

In 1881 James Powell Swift was making a microscope with the Lister limb ¹¹ and in the " Challenge " and " Paragon " microscopes he had re-introduced the Jackson grooves, ploughing those for the slide and the substage in one setting. We shall see later that in the 1881 microscope he also introduced important improvements in the focusing both of the coarse and the fine adjustments.

Thus the English makers were at the beginning of my period making a form of microscope which, after a period during which most makers were temporarily obliged by the mistaken demand to adopt the " Continental " model, has returned (in a more massive form) as the form best suited to carry the modern high-aperture objective. For it is obvious that the nearer the adjustment slides can be brought to the axis of the body, the

* According to a letter of A. A. C. Eliot-Merlin to S. C. Akehurst of July, 1934 (now in the library of the R.M.S.), the first five chapters of the 1891 edition of " Carpenter " were written by E. M. Nelson, so it is no doubt actually Nelson's opinion that is here quoted.

less effect will any slight shake have on the rigidity of the body and the less will be the apparent movement of the object under observation caused by the pressure of the hand when focusing or moving the object on the stage, or due to the contact of the head with the eyepiece.

The first of the Continental makers to make the Lister limb was the firm of Leitz, in 1903, who adopted it on all their larger stands, as shown in fig. 1, on the introduction of their cam fine adjustment, to which I refer later.

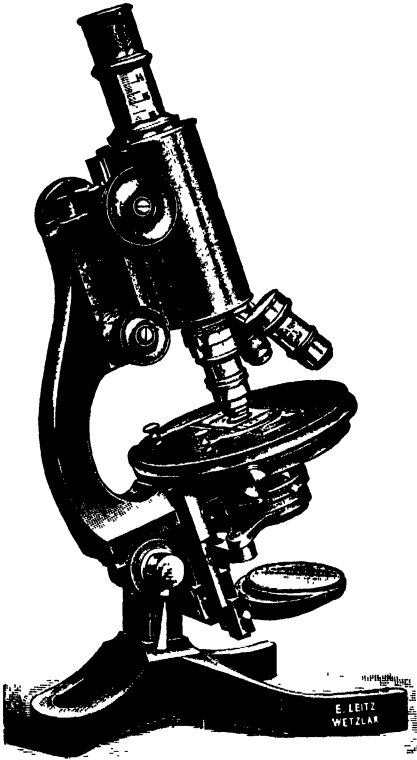


FIG. 1.

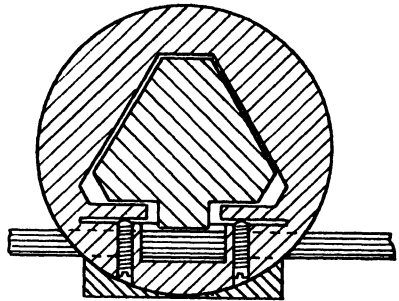


FIG. 2.

The Slides.—I have just said that the microscopes at the beginning of my period were built either with the prismatic bar of Powell and Ross or with the Lister limb as made by Swift and R. and J. Beck.

In the Ross microscope the bar was supported at the lower end by a sprung ring sliding in the inside of the tube and at the top it passed through a plate (fig. 2), which had two saw-cuts, the partly separated pieces being pressed forward by screws to grip the bar.

Powell, on the other hand, from his first large microscope made for the Society in 1841¹² and his bar microscope of 1843,¹³ always used springs to press the prismatic bar into its fitting. These springs, one on each side of

the rack, kept the slanting sides of the bar against the corresponding slanting sides of the block.

This is the method used by Zeiss up to the present day for all their slides. They place a pair of nearly straight springs one on each side of the rack ; the springs are very stiff and they are adjusted so that while their normal pressure is moderate their yield is small. Thus the slide, while the friction is not too great, is yet very rigid.

The slides of those makers using the Lister limb were necessarily made on a different plan. In the microscope made also in 1841 to the order of the Society,¹⁴ Smith and Beck used a dovetail V working in a solid member. This was slightly altered in their microscope of 1851 (the V being reversed) to the form shown in fig. 3, and this modified form has become the standard for such a slide.

Some makers have now further modified this into the form of fig. 4, in which a cylindrical bar replaces the V. This bar works in a cylindrical

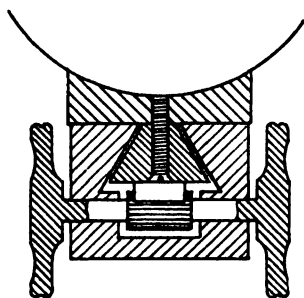


FIG. 3.

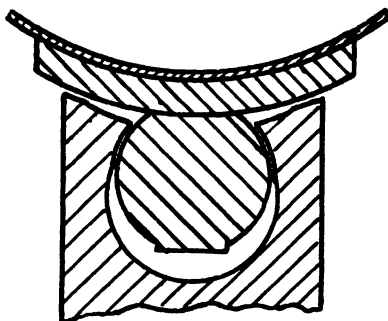


FIG. 4.

groove of a slightly larger radius. The bar only bears on the groove for a short distance on each side, and to obtain a good surface of contact the groove is milled for this short distance to the same radius of curvature as that of the bar. These members are both made solid throughout, without any spring adjustment.

In fitting the V or prism, some makers made saw-cuts and forced the partly separated portions forward by screws, as had been done by Ross. If the other member is accurately parallel, such a slide will work well for a time, but if only a point, or at most a line, is brought into contact as the working surface, not only will it rapidly become loose with normal wear but also any sudden jar may pit the other slide opposite the points of contact and so spoil its surface. These criticisms become less important if the original fit is a good one and the surfaces are almost in contact all over before the screws are brought into action, because then a very little rubbing together with oil should bring a comparatively large area into contact. Messrs. W. Watson and Sons from 1885 have employed this method of

adjusting the slides, and still consider it satisfactory. By a slight adjustment of the screws, if done as soon as any looseness is observed, the surfaces should again be made to touch over a large area.

An improvement in the design of this type of fitting was introduced by Swift in 1894 in his *New Histological and Physiological Microscope*,¹⁵ in which the limb was split nearly through its length by a saw-cut so that it could be drawn together upon the slide working within it; in this way he substituted a line for a point contact. A further improvement on this

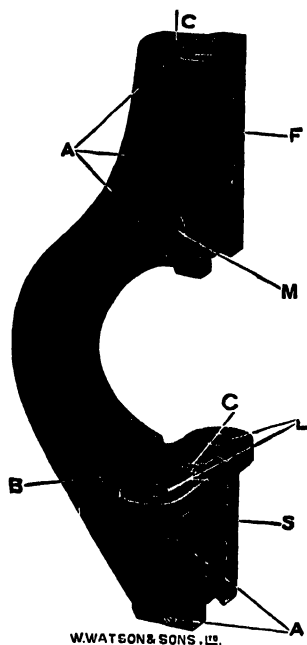


FIG. 5.

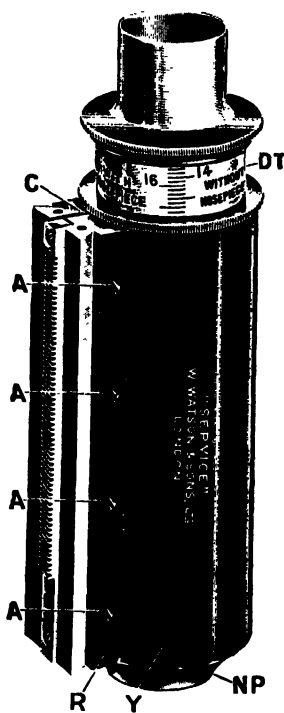


FIG. 6.

construction was introduced by W. Watson and Sons in 1922 under a patent of M. T. Denne¹⁶ (fig. 5), by arranging slightly to tighten the screws A, so that the casting is slightly strained together before machining the grooves; after the machining the screws are loosened and the other slide inserted; then after tightening the screws the slides are worked together with oil only. This causes a slight flow of the metal, the surfaces are smoothed and hardened and also if the original tightening has been correctly judged, the surfaces will now be brought into contact over all their area. This will give the bearing a long life. Should it become loose in course of time, a slight adjustment of the screws will once more make the fit good, and if this is done before the wear has become excessive, the surfaces should again touch

over a large area within the limits required to support the film of grease. Under the same patent the other slide for the coarse adjustment is arranged to be adjusted on the same principle but in a somewhat different manner. In this case the male member, fig. 6, is split nearly through, along its length. Screws in this are arranged to enable them to force the two portions apart. Again the screws are tightened before the slide is machined and the fitting is done in the same way.

But, speaking generally, sprung fittings have been liable to abuse and often been used to cover up poor workmanship. They have made it possible to turn out cheap instruments which will work well when new, but will early show signs of wear and soon become useless even for medium-power work.

Hence in the better type of instruments there has recently come about a reversion to the construction of the solid slides, abolishing altogether the use of springing and relying entirely upon the accuracy of the fit. This has been made possible by the introduction of precision machines which can produce grooves and prismatic members which are accurately parallel as they come from the machines. The machine that is used is a milling machine with accurately running spindle; thus in the construction of the slide of fig. 3 the prism to be milled is mounted on an axis by means of which the surfaces to be milled can be brought in turn into position for the cut. The internal slide is milled by shaped cutters at one setting. As the working faces of the slides make acute angles with one another, final fitting can be obtained by removing a small amount from the back of the male member, but even this should not be necessary if the machining is sufficiently accurately done. Some makers, however, prefer to leave a little to be removed by fine papering in order to remove any slight ridges left from the cutter. If this is not done, the milling should if possible be so carried out that the ridges left from the cutters on the two sliding members shall be perpendicular to one another.

When true contact is obtained, not only is the life of the bearing lengthened as compared with that of a bearing with point contacts, but the slides will be far more rigid, since the whole area shares the load and the force required to squeeze out the lubricant becomes almost infinitely greater than that required with a point or even a line contact.

The microscopes of the English makers, Baker and Swift, have slides working on the principle above explained and among foreign makers are those of Bausch and Lomb and Reichert.

As I have said, Beck since 1841 made their slides in this way with a V that was capable of adjustment; in 1922 they decided to make both members solid out of single pieces of metal and fitted directly from the machine. In 1929 they adopted a design for their "London" microscope¹⁷ which is a still greater test of the accuracy of manufacture. By a specially built machine, two holes are bored through both members of the slide, which are truly parallel to one another and of the same diameters. Through these holes they pass two bars of stainless steel which are accurately cylindrical

and true to $\frac{1}{1000}$ inch. As a result the moving member is held with great rigidity and can yet slide perfectly freely along the bars. The moving member is entirely enclosed within the limb and therefore fully protected from dust.

Messrs. Leitz have broken entirely new ground in their ball-bearing slides, introduced in 1926 ¹⁸ (fig. 7). The slides have hardened steel strips let into saw-cuts on which the balls run and are designed on "geometrical" principles. On the moving member there is only one V and the other balls run on it on planes. There are four sets of balls on each face (instead of three only as required in principle) and each set consists of three balls (instead of one only); these increases in the number of balls are to enable

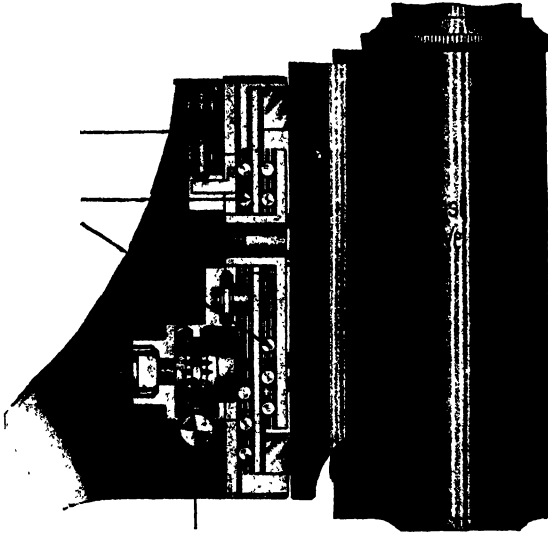


FIG. 7.

the slides to sustain greater loads without risk of indentation. The outer fixed members are held together by a strong central screw and form an enclosed box; this box has two slots, one at the front to pass the block which connects the slide to the next slide (of the coarse adjustment); and one at the rear to pass the support of the wheel which runs on the heart-shaped cam by which the movement of the fine adjustment slide itself is produced. This firm is using ball-bearings in their recent models in several other places—for the rotation of the stage, for the traverse of the stage, for the traverse of the whole microscope. In these latter movements, the moving member is mounted in the same way as some of the ordinary type-writer carriages, with the balls in one plane between the V-edges of the two members.

I may mention that Messrs. Swift in 1907 for a time used ball-bearings for the rotating stage of their "Photographic Petrological" microscope, but

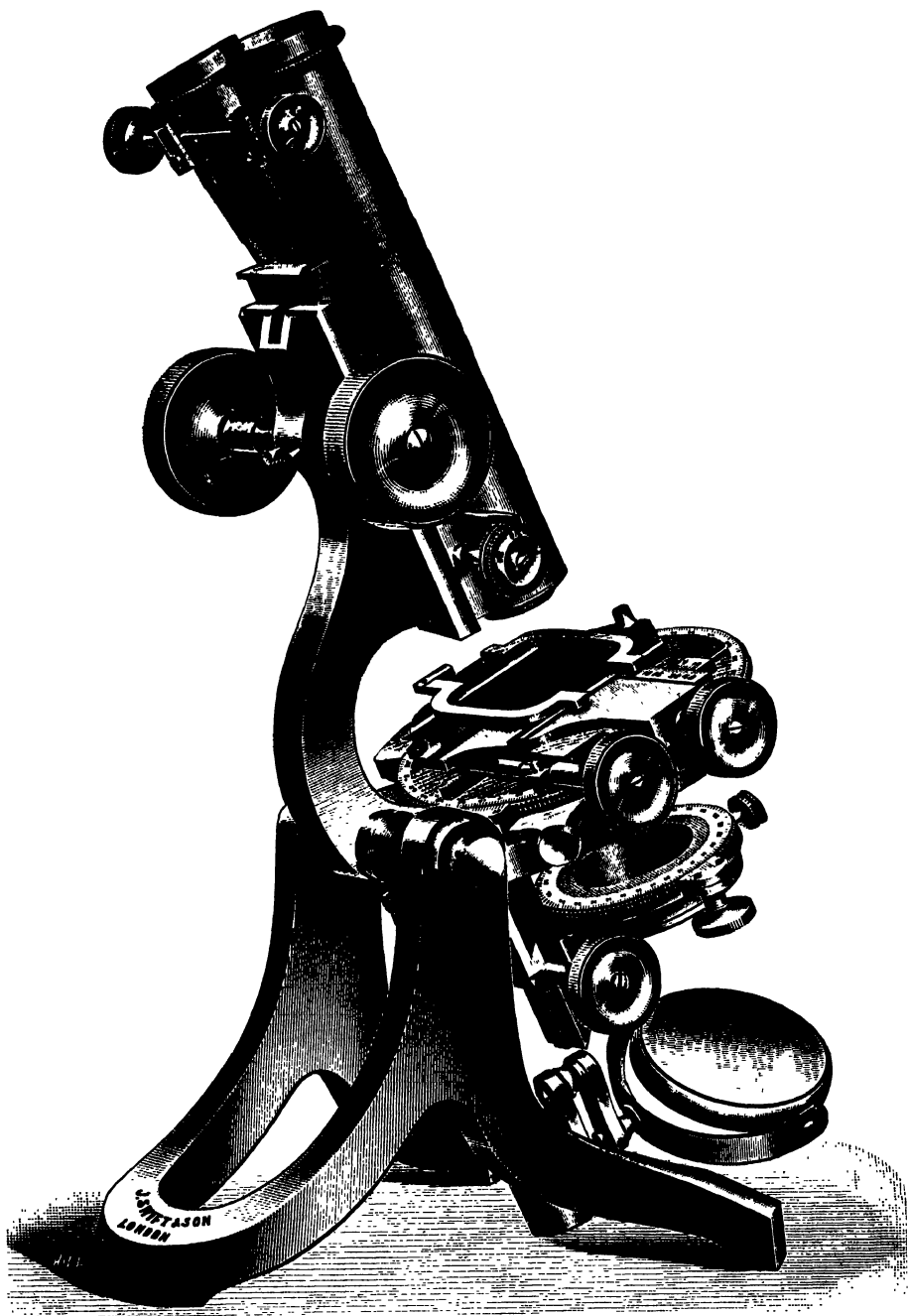


FIG. 8.

they abandoned them, as they found that when the instrument was inclined the weight of the handles on the side of the stage caused it sometimes to rotate of its own accord.

The Coarse Adjustment.—By far the most important improvement ever made in the coarse adjustment was the introduction of the diagonal rack, which was first made by Swift in 1880²⁰ and applied to the 1881 “Challenge” (fig. 8) microscope above referred to. The rack was cut diagonally, but the pinion was made by twisting by hand an ordinary straight piece of pinion wire. To do this the two ends of the piece of wire were filed down flat (like the end of a screwdriver); corresponding flat holes were made in the middles of two old files. One file was held in the vice and, one end of the wire being held in it, the other end was slowly twisted, cold, to the required amount, determined by placing the rack against it. It was said that the twist was made slightly too great, so that when placed together the angle was about 91° instead of 90° . This diagonal rack gave a very smooth movement and has now been universally adopted. The only difference is that the pinion since about 1905 is cut to the correct angle by special machines as well as the rack, both with involute teeth. The old twisted pinions, however, worked wonderfully well—almost as well as the cut ones.

The Fine Adjustment.—The forms of fine adjustment that have been devised from time to time are far too numerous even to mention, but they may be divided into four main types: (a) the direct screw as used in the “Continental” microscope; (b) the long lever, originally used by Powell in 1848; (c) the side lever, invented by Swift in 1881; (d) the inclined plane.

(a) There are two modifications of the *direct screw* which should be mentioned. The first is the use of a differential screw. This was invented by Dr. William Hunter in 1780,²¹ who actually applied it to a simple microscope. It was again invented by Nobert about 1860. Joubert took out several French patents in 1866. E. Grundlach used a differential screw in 1881,²³ and it was once more invented by Rev. James Campbell in 1886.²⁴ This screw was used by Swift in his 1894 Histological Microscope already referred to, and Baker used it from January, 1887, till 1911.²⁵ The second modification is the introduction of levers between the end of the screw and the top of the slide by which the movement of the screw is reduced. This was done by Reichert in 1899²⁶ (fig. 9), and by Swift in a slightly different form in 1900²⁷ (fig. 10).

(b) The *long lever* in its simple form is still used by Messrs. W. Watson and Sons (fig. 11); it has seen a number of modifications. In 1901 Beck²⁸ obtained two speeds for the fine adjustment by the use of two concentric screws of different pitches. F. Watson Baker, of Messrs. W. Watson and Sons, in 1902²⁹ also obtained two speeds by pivoting a second lever to the long end of the main lever and acting on the long and the short ends of this lever by two separate screws. In 1893 Watson in the “Van Heurck” microscope³⁰ had adopted the long lever to move the fine adjustment with the Lister limb, adding an intermediate rod (fig. 11) to convey the motion

from the lever to the slide ; this rod both reduces the friction and also prevents any irregular side-play of the lever from being transmitted to the slide. This firm has continued to use this lever to the present time.

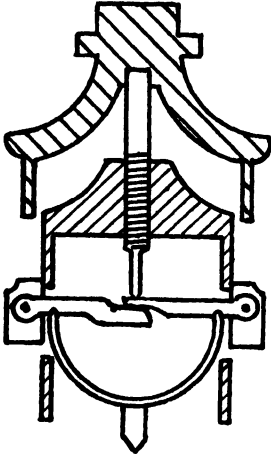


FIG. 9.

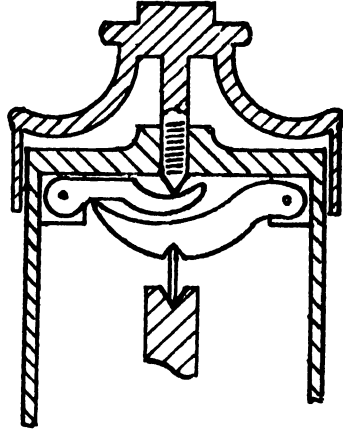


FIG. 10.

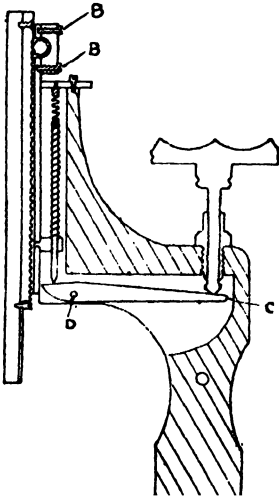


FIG. 11.

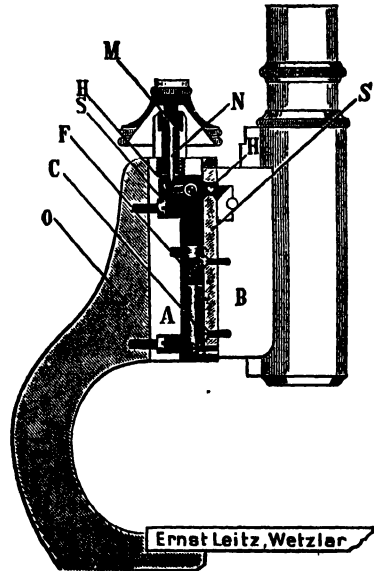


FIG. 12.

Leitz in 1912 used a short lever to transfer the motion of the screw to the slide in their school microscope as seen in fig. 12, in order to make use of the Lister limb for this microscope.

(c) The *side lever* of Swift (fig. 13) was, as the "Climax" movement, first applied to move the nosepiece only³¹ of the 1881 "Best Challenge Microscope," to which I have already referred (fig. 8), but, as this was criticized as producing alterations in the length of the tube, in 1886 he applied it, by the addition of an extra slide, to produce movement of the whole body.³² I may mention that in 1892 Swift used a similar lever to focus the substage.³³

The side lever of 1886 had one screw, placed sometimes on the right of the limb and sometimes on the left. At a later date Swift carried the screw through the limb with a knurled head on each side, the screw of course travelling along as it was turned. There was a collar on the screw near its

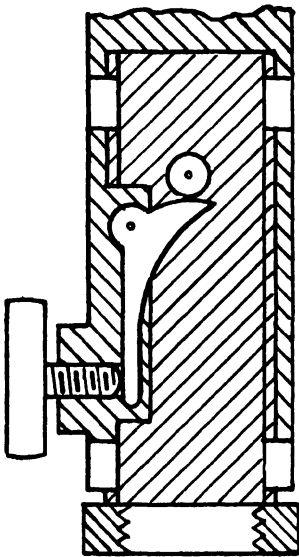


FIG. 13.

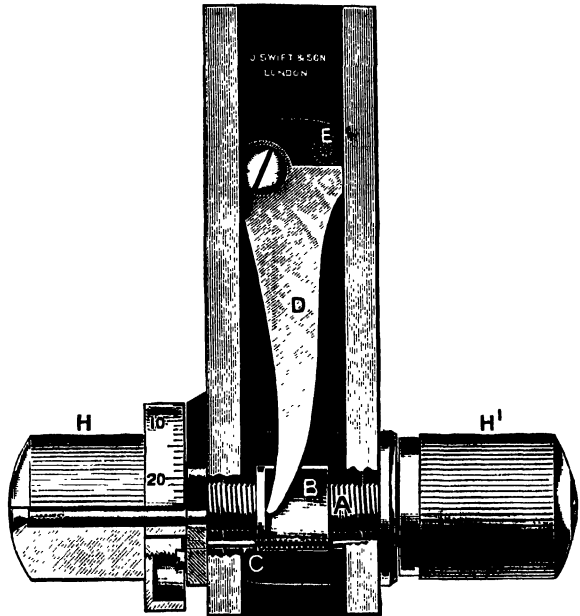


FIG. 14.

middle which pressed against the long end of the lever; a spring acting on the side opposed the motion produced by the lever and prevented lost time. In 1911 Swift further modified this by adding a bronze nut to the screw (fig. 14), which nut was prevented from rotating by a groove which fitted round a steel rod, the screw was fixed lengthways and the nut travelled along as the screw was turned and so moved the end of the lever. As the screw worked in close-fitting bearings at each end and the nut was entirely enclosed in the body of the limb, this prevented the access of dust to the screw and made it a most effective form of adjustment. This has been copied by several makers. In the form made by Baker (who used the first form with the travelling screw from 1912³⁵ and the second form with the nut from 1931) a spring urges the screw against a ball-race between hardened steel washers;

a collar on the screw is adjustable to take up end-shake ; and the axis of the screw is held in a second collar which can be tightened to any extent desired to give a pleasant motion to the screw.

Messrs. Watson make a very similar motion for their "Service" microscope, introduced in 1922 (fig. 15).

The Zeiss fine adjustment is a modification of the long lever which was introduced by Meyer in 1921. The knurled heads are mounted on a pinion which meshes with a clock-wheel mounted on a second pinion, and this pinion meshes with a radial rack on the end of the long lever. The lever

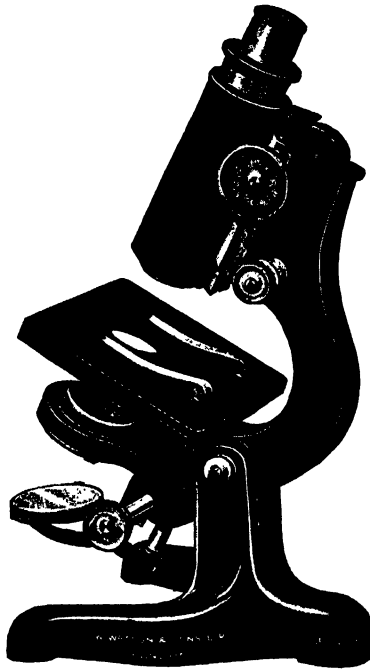


FIG. 15.

is mounted on knife-edges and a short rod conveys the motion of the short end of the lever to the slide. A strong spring opposes the motion of the slide and by keeping the pressure always on the same side of the teeth of the pinions and rack, prevents lost time. They claim that this clockwork mechanism has a further advantage in that it requires no lubrication. Before the introduction of this motion, Zeiss had been using a motion devised by Berger in 1898³⁷ in which a wormwheel, moved by an endless screw situated between the two knurled heads, turned a direct acting screw pressing on a projection on the slide. A spring as usual opposed the action of the screw.

Baker in 1910 used a similar wormwheel and direct-acting screw, and in 1920 improved this by mounting a nut on the screw and fixing the screw

lengthways. The nut was V-shaped at the top and the V fitted into a slot in the projection from the slide, thus preventing the rotation of the nut and making the contact with the slide.

The differential screw and the slow-turning direct acting screw of Berger and Baker both suffer from the fact that any imperfections of the screw are directly transmitted to the slide, which thus becomes a sensitive indicator of these imperfections ; whereas when the screw acts on the long end of a lever of which the short end is used to impart the motion to the slide, these imperfections are reduced in the ratio of the arms of the lever, and in the case of a reasonably good screw become imperceptible.

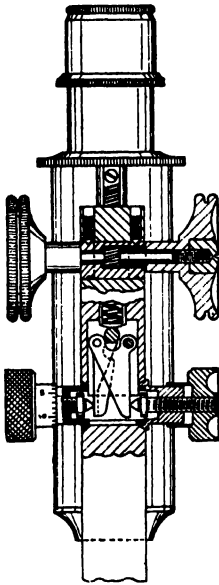


FIG. 16.

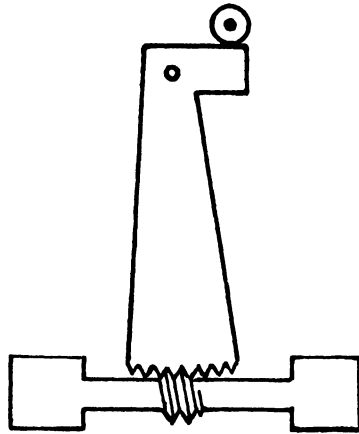


FIG. 17.

In 1919 Messrs. R. and J. Beck made an ingenious modification of the side lever, by mounting a second lever on the face of the first one ³⁸ (fig. 16). There are two knurled heads, one on each side of the limb, each acting on one of these levers, and by the use of screws of different pitch one lever is made about four times as sensitive as the other. Thus not only can both hands be used as usual, but they will move the body at different rates.

Messrs. Bausch and Lomb ³⁹ in 1915 introduced still another modification of the side lever. The long end of the lever (fig. 17) is cut to form a short portion of a wormwheel meshing in an endless screw actuated by the knurled head. The sensitivity is about the same as that obtained by the nut of Swift. In 1931 ⁴⁰ a nut was added, running on a coarse thread cut further along on the same screw, to limit the rotation of the screw and so prevent damage to the fine thread which operated the segment. In order

to bring the knurled heads to coincide with the axis of the trunnion (where they will have less tendency to cause shake than in a position higher on the arm) in 1934 ⁴¹ they greatly enlarged the lever, at the same time turning its plane through a right angle into the plane of the arm. Its long end was made to reach and be acted upon by a cam cut on the surface of a nut which travelled in the usual manner along a screw with knurled heads at each end

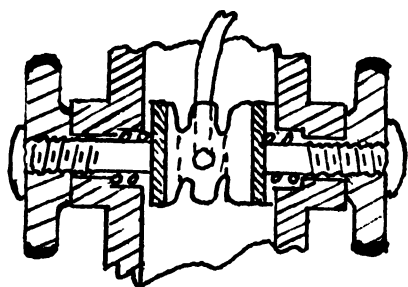


FIG. 18.

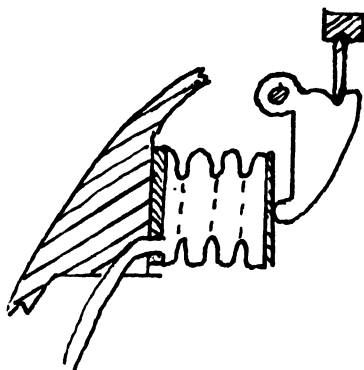


FIG. 19.

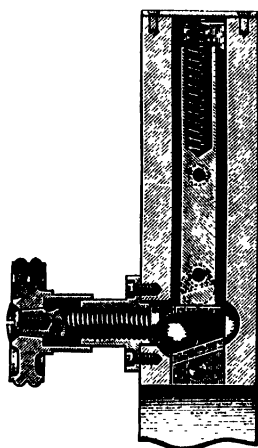


FIG. 20.

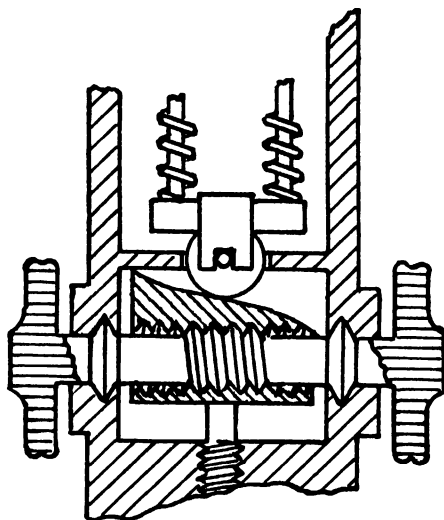


FIG. 21.

The most interesting of the modifications of the side lever, made also by Bausch and Lomb, was the adoption of hydraulic means for the transfer of the motion to the lever in a patent of 1937.⁴² A short bellows made of corrugated flexible tube was mounted between the heads (fig. 18), the ends of the bellows were pressed together by springs and kept apart by screws actuated by the heads; thus rotation of either head altered the

volume of the bellows. A tube connected this bellows with a similar one (fig. 19) (which may be of larger diameter to reduce the motion), having one end fixed and the other end pressing against the long end of the Swift side lever.

(d) The *inclined plane* was used in a motion by Leitz in 1918 ⁴³ (fig. 20), who forced a ball along between two inclined planes. Almost the same design was also tried by Baker in 1920 in their "Student's" microscope. This was not good mechanically, as the ball has to slide and not roll.

In 1905 Reichert ⁴⁴ rotated a wormwheel mounted on a vertical axis and carrying a short helix of one turn, on which a small wheel rolled; the wheel was attached to the slide and raised it as the helix was turned (fig. 21).

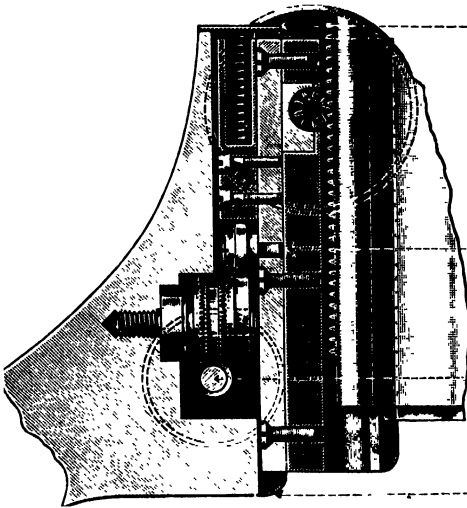


FIG. 22.

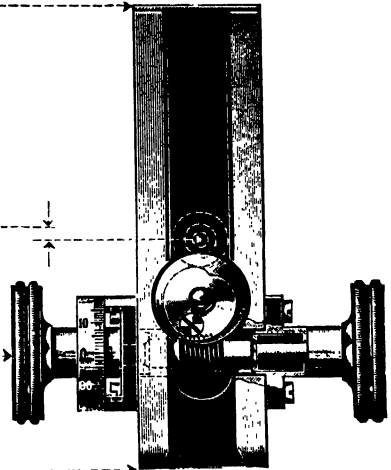


FIG. 23.

In 1903 ⁴⁵ Leitz adopted as their standard motion a wormwheel rotating about a horizontal axis, moved as usual by an endless screw and carrying on its face a heart-shaped cam (fig. 22 and 23). A small wheel, attached to the slide, rolled on the edge of this cam (fig. 23). In 1912 it was improved by mounting the worm and cam on the end of a screw that goes directly into the arm, thus enabling the slide to be brought close to the cam. The pinion, on which is the endless screw and the two knurled heads, has a ball-race to take the thrust. In 1928 ⁴⁷ a stop was added to limit the rotation of the cam, so that only one-half of it could be used, and the observer would therefore know in which direction he was moving the slide as he rotated the heads.

The Binocular Microscope.—One of the most noticeable changes of recent years has been the large increase in the use of the binocular body, especially since its design has made it possible to use it for high-power work.

The binocular microscope was invented by Prof. J. Riddell in 1853 ⁴⁸ (fig. 24, *a*). He placed two right-angle prisms over the objective, dividing the field into two equal parts and reflecting the half beams to right and left respectively. Two other right-angle prisms, one on each side, reflected these beams up two parallel tubes to the eyes of the observer. Ross, with the well known Wenham prism (fig. 24, *b*), also divided the field into halves. This division, however, halves the resolving power of the objective.

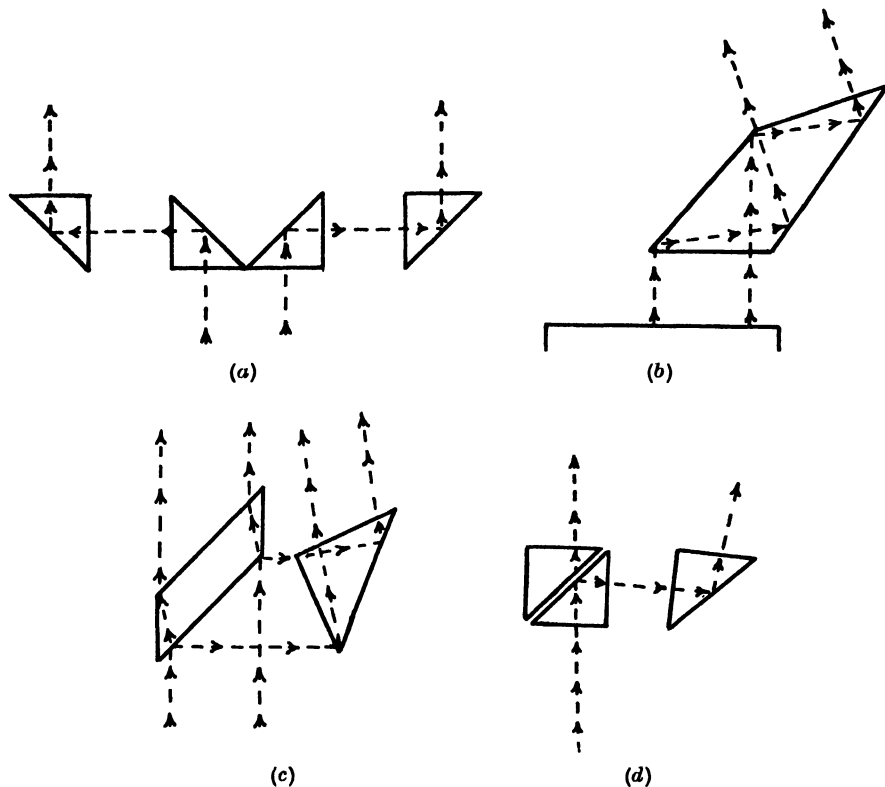


FIG. 24.

Powell and Lealand, and later Powell with the Powell-Wenham ⁴⁹ prism (fig. 24, *c*), used the whole field by reflecting the beam to one side by an inclined air-glass surface. By increasing the inclination of this surface to the direction of the beam, the intensity of the reflected beam can be increased, but it cannot be made equal to that of the transmitted beam. Much later Abbe used nearly the same prism but placed it at the top of the tube ⁵⁰ (fig. 24, *d*). Unfortunately, however, all these devices made the optical paths unequal.

The first successful microscopes for high-power work were introduced almost simultaneously by Beck and by Leitz in 1913.

In the Beck model ⁵¹ (fig. 25) a semi-silvered surface at an angle of 45° , separating two prisms, reflected part of the beam to one side, where it fell on a totally reflecting surface of the second prism which sent it up a side tube inclined to the main tube, to one eye, while the transmitted beam went on up the main tube to the other eye. The axes of these tubes met about half a metre below the eyepieces. This arrangement had the advantage that it could immediately be converted into a monocular by sliding the prism to one side. But it had the great disadvantage that the interocular distance had to be adjusted by altering the length of the tubes, and, owing to the small inclination of the tubes to one another, this alteration in length was some six or eight times as great as the consequent alteration in interocular distance. The inequality in the optical paths was to some extent compensated by adding a block of glass to the side prism, thus substituting a long path in glass for a shorter one in air; but this compensation is not ideal, for the paths can only be made equal for a single colour.

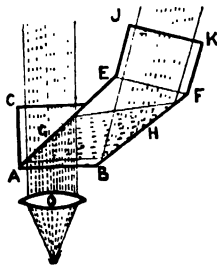


FIG. 25.

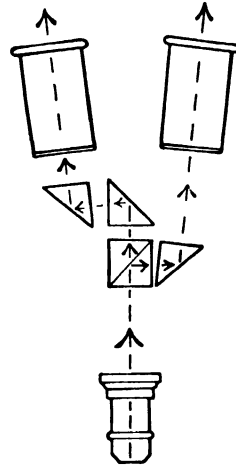


FIG. 26.

At the same time, in 1913,⁵² Dr. F. Jentzsche of Messrs. Leitz introduced the system which is now practically universally used (fig. 26) (the figure is the form used by R. and J. Beck with convergent tubes). It is very similar to Riddell's original system, except that Jentzsche used a semi-silvered prism embracing the whole beam instead of Riddell's pair of right-angle prisms each taking only half the beam. The semi-silvered surface separating the prisms reflects half the beam to one side (as was done by Beck) and this is reflected up parallel to its original direction by a right-angle prism (as was done by Riddell). The beam transmitted through the semi-silvered surface is reflected by a total reflecting surface of the second part of the prism or by a separate right angle prism to the opposite side, where it also

is reflected up by a right-angle prism parallel to its original direction. These two beams enter two parallel eyepieces and so pass to the eyes of the observer. An extra block of glass is added to one of the prisms in the first beam to make the optical paths equal (which it can do accurately). The interocular distance is adjusted by moving the side prisms and tubes nearer to or farther from the central prism. The change in tube length is thus only half the actual change in the interocular distance and is usually negligible.

As each of the beams is formed after two reflections from a pair of parallel surfaces, the image will not be affected if these surfaces are rotated,

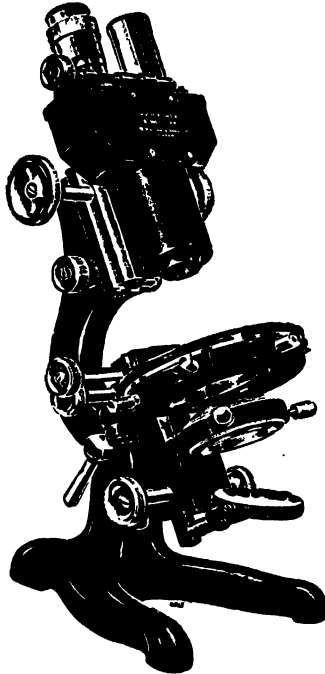


FIG. 27

provided only that the two surfaces of a pair of reflecting surfaces are maintained parallel. This gives an alternative method of adjusting the interocular distance which is the one used by Zeiss, Beck, and others. The lower semi-reflecting prism is made into a cube, and with its side prism, tube, and eyepiece is mounted as a rigid whole member; similarly the upper prism, side prism, tube and eyepiece are mounted together as a second member, and these members are hinged together, so that the eyepiece separation can be varied by bending the hinge. Some makers alter the separation between the central prism block and the two side prisms; this is done, for instance, by Messrs. W. Watson and Sons (fig. 27) and by Baker.

Most of the English makers, e.g. Messrs. R. and J. Beck, instead of making the angle of the side prisms 90° , increase this by some 3° to about 93° , as in fig. 26 ; this produces an inclination of the reflected beams of about 12° to one another and makes the microscopes easier to use by most people. It has often been stated that when one has once become accustomed to the parallel tubes they are less tiring to use than convergent ones, as they cause the accommodation to be relaxed. It is true that accommodation and convergence are closely related and that one accommodates as one converges ; but accommodation is also associated with the distance at which we expect to find the image and also in looking downwards one automatically tends to accommodate. (It is said that this is one reason why some people become giddy in looking down from a height.) An observer looking through a microscope knows that the object is close to him and expects to find the image also near ; moreover, he is looking downwards. He is therefore strongly urged to accommodate for some short distance. It is therefore at least doubtful when using parallel tubes if he will not still accommodate for a near point. Thus, while it is possible that a few observers may relax their accommodation, I believe the great majority do not do so. Nor, in my opinion, is it in any case of any real advantage to have the accommodation relaxed, for if it were we ought to find it an advantage to use spectacles for reading which had prisms to render the eyes parallel and with the power required to bring the focus to infinity, but this has never even been suggested. Then why should we expect to do it with the microscope ? I am firmly convinced that the theory that parallel tubes are any more restful is mistaken. On the other hand, the parallel tubes have two important advantages : they allow the interchange of parfocal eyepieces which stand up to different heights above the top of the draw-tube, and they also allow the eyes to be raised above the eyepieces (e.g. when wearing glasses) without affecting the interocular distance. Thus although parallel tubes do *not* cause any relaxation of the accommodation and are therefore no less tiring than convergent tubes, yet as after a little practice one easily becomes accustomed to the parallel tubes (and the consequent dissociation of convergence and accommodation), it is possible that these two advantages—especially the first one—may cause the parallel tubes to be preferred to convergent ones.

Inclined Eyepiece.—In 1860 Nachet invented the prism of fig. 28. The light entering the lower face of the prism is reflected at the upper face (which is silvered over this portion of its area), totally reflected at the lower surface, and then inverted by two reflections in the roof-prism. Very little use, however, was made of this or any similar prism until recently ; but in the last few years most makers have put on the market microscopes with inclined eyepieces. Zeiss and Bausch and Lomb have used a simplified Nachet prism in which the roof-prism is omitted and the light allowed to emerge through the third surface, which is cut normal to the beam (fig. 29, *a*), after its total reflection from the lower surface (the upper surface has to be silvered as in the Nachet prism). These firms have also used the gun-sight

prism of fig. 29, *b*. In this prism the light enters the prism at the bottom, is totally reflected at the hypotenuse face, is reflected again at the vertical face (which has to be silvered), and then strikes the hypotenuse face a second time, but this time it meets the face at normal incidence and thus passes through. This prism gives an emergent beam at 60° to the horizontal, while the modified Nachet is arranged to give a beam at 45° to the horizontal.

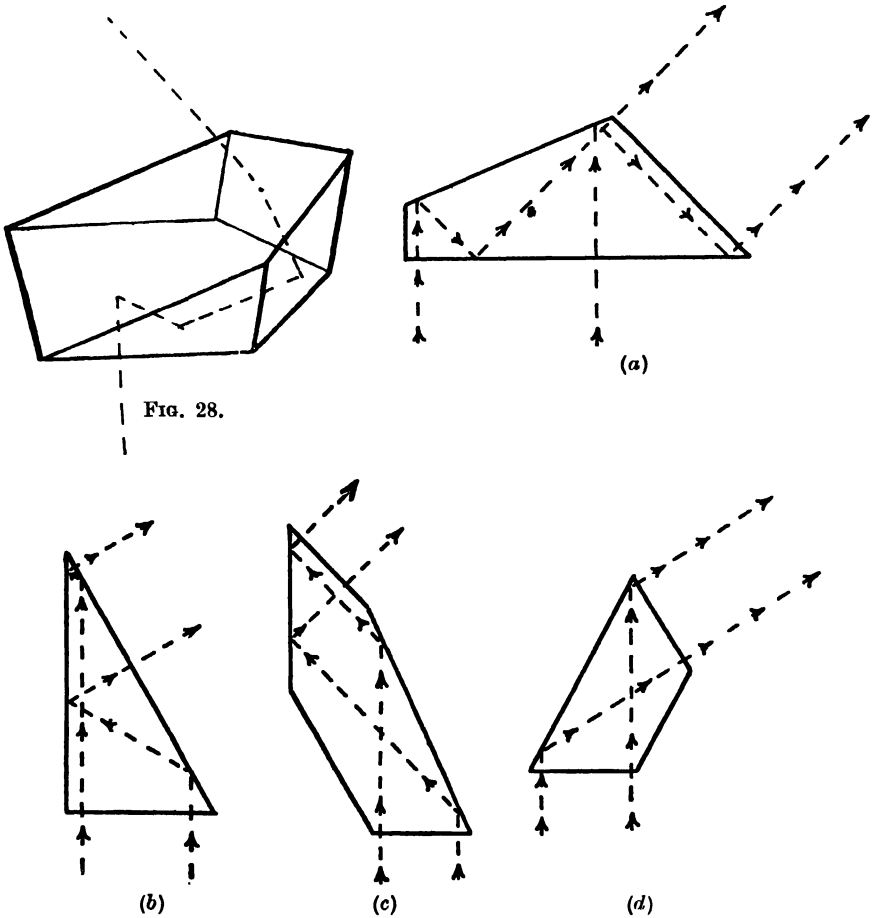


FIG. 28.

FIG. 29.

Leitz uses a modification of the Wollaston or Wenham prism, as shown in fig. 26, *c*. The light is twice totally reflected and emerges at 45° to the horizontal.

Beck uses a single total reflection, as shown in fig. 29, *d*.

The modified Nachet prism of fig. 29, *a*, would appear to have the advantage of affording the shortest path and thus adding least to the total path.

The use of such a prism makes it unnecessary to provide for the inclination of the microscope and thus enables the stand to be made both simpler and firmer. Also the horizontal stage which is used with it has several advantages, e.g. a slide does not need to be supported, loose specimens of minerals can be placed upon it, liquids do not tend to flow down the slide, and troughs of liquid can be used.

Interchangeability.—A most valuable improvement was introduced by H. Heine of Messrs. Leitz in 1922, who, in addition to slides for the fine and coarse adjustments, added a simple dovetail slide, by the use of which the body could be at once removed and replaced by another one, e.g. a monocular by a binocular one (fig. 30). The fit of this slide is made a loose one, so

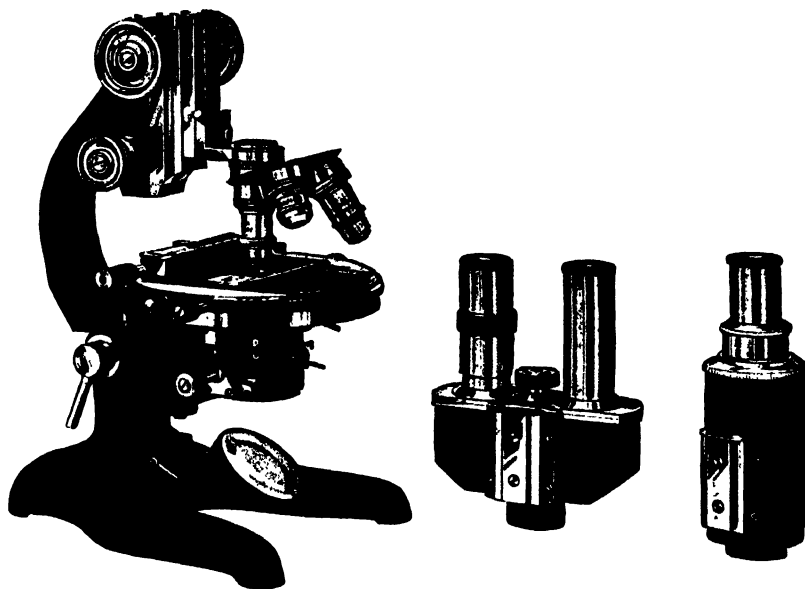


FIG. 30.

that the change can be made with little disturbance of the adjustments. There is a simple clamp on the side of the groove by which the slide can be fixed firmly.

This system has been adopted by all makers (though not necessarily in the same form), as it gives a great flexibility to the instrument.

Astigmatism of the Observer.—I should like to refer to one improvement that should be introduced more generally. A large proportion of all users of the microscope are astigmatic to a greater or less degree. It is well known that an astigmatic person will bring on a headache if he attempts to read even for an hour without his glasses. Yet if he is using a microscope he either has to do this or to attempt to work while wearing his glasses; if he retains his glasses he finds superimposed on the image in the microscope the

reflections from the room produced by the surfaces of the lenses. I find that it is most rare for a cylindrical lens-cap to be supplied for such workers ; but surely everyone suffering from astigmatism should, as a matter of course, use correcting cylinders, both because he will get a better image and because he will reduce eye-strain.

It is easily possible to make a fitting which will correct any error less than two diopters (and it only occasionally exceeds this amount). If two 1.00 D. cylinders are placed together with their axes parallel, they are equivalent to a cylindrical lens of 2.00 D. power. If one of these cylinders is now rotated over the other, the cylindrical power will gradually fall to zero and the combination will become equivalent to a simple sphere of power 1.00 D. when their axes are at right angles. Thus by mounting two such cylinders in a cell with a pinion arranged to rotate them over one another in opposite directions, and mounting this cell above the eye-lens, any astigmatic error up to 2.00 D. can be corrected. The cell must of course be capable of rotation to bring the combined axis into the right direction.

The Foot.—The various forms of tripod have altered little. It is of course necessary that the centre of gravity of the microscope shall remain well within the area subtended by the foot in all positions of the instrument. The stand designed by the American, George Wale, and adopted by Swift in the "Wale" microscope in 1881¹¹ gave a very firm mounting for the microscope in all positions. In this stand, in place of a hinge there is a semi-circular groove on each side of the limb into which corresponding projections of the foot enter. The same principle in a somewhat different form had been used in the Ross-Zentmeyer microscope, and has again been used in Beck's "Radial" microscope of 1923.

The usual method of suspending the limb is to mount it on trunnions working between the faces of two pillars of the foot ; a clamping screw draws the faces together. Some makers (e.g. Leitz) have a handle on the clamping screw to tighten the joint when the desired inclination has been obtained, and in this case they may make a saw-cut in the foot so as to give greater freedom for the faces to be drawn together.

Baker, instead of drawing the two feet together, makes a clearance hole in one foot in which the clamping screw on that side fits, and all the actual clamping is done on the opposite foot. Celluloid washers are placed between all the moving faces to give an increased smoothness to the motion.

The Finish.—The older makers used brass entirely for their stands (except in very cheap instruments) and used to file them all over, polish them, and lacquer them hot with a brush. Most makers now use black enamel to cover the castings and the greater part of the instrument, which is applied with a compressed air-spray and stoved. This enables iron to be substituted for brass for the foot and limb without any sacrifice of appearance. The castings are worked up with emery bobs and rubbed with some composition which hardens with heat (I presume a fire-clay preparation such as pyruma) to fill in all pores and holes. They may be given as many

as three coats of enamel. When it is not desired to work up the stands to a smooth finish, "crystal" enamel is used, as this disguises the roughness and gives a satisfactory uniform finish.

Special Microscopes.—I have not attempted to deal with the many special types of metallurgical, petrological, mineralogical, ultra-violet, micro-photographic, and other microscopes, but merely tried to trace the development of the ordinary microscope on its mechanical side, and to show what changes have been made, giving as far as I could the name and date of the originator of the change.

There can be no doubt that the standard of construction has very definitely risen in quality in spite of—or perhaps in consequence of—the substitution of the machine for the hand work which the period under review has covered.

ACKNOWLEDGMENTS.

In conclusion, I have to thank very warmly Messrs. Baker, Bausch and Lomb, Beck, Leitz, Swift, Watson, and Zeiss for the great help which they have all given me in my task, without which it would have been impossible for me to have obtained my information, and also for the loan of instruments, slides, and diagrams for the lecture and for the loan of blocks for the printing of the paper. My special thanks are due to Mr. W. Wiedling, who persuaded Messrs. Leitz to bring over their latest research microscope and exhibit it to the members present, all of whom were greatly interested in this fine instrument. As I understand that it is shortly to be described to the Society, I will not attempt any account of it here.

APPENDIX 1.—THE MAGNIFICATION OF IMAGE GIVEN BY THE MICROSCOPE.

Magnification of a Lens.—Although everyone appears to know that the magnification of a lens is given by the ratio of the distance of the image from the lens (really from its principal plane) to the distance of the object from the lens, it is much less well known that it is also given by the ratio of the distance of the image from the second focal plane to the focal length of the lens. This latter formula is often the more useful; for instance, if one wants an enlargement of a given number of diameters, it is only necessary to measure that number of times the focal length of the lens from its back focal plane and to place the screen in the position so found.

Magnification of a Micro-eyepiece.—Thus in the case of the microscope, if it is agreed that the final image shall be assumed to be formed at a distance of 250 mm. from the upper focal plane of the eyepiece, then the magnification produced by the eyepiece must be equal to the number obtained by dividing 250 by the focal length of the eyepiece in millimetres.

Magnification of a Micro-objective.—Similarly in the case of the objective, if it is agreed that the image shall be formed at a distance of 160 mm. from the plane of the collar of the mount, then its magnification will be given by dividing the distance of this plane from the upper focal plane of the objective by the focal length of the lens itself. If this magnifying power is given, the magnification when the image is formed at any other distance will be obtainable either by dividing this new distance from the upper focal plane by the focal length of the lens, or by increasing the number given as the magnifying power of the lens in the ratio of the new distance to the old. In the case of any lens of higher power than, say, 10 mm. focal length, the upper focal plane is never far from the plane of the collar of the mount; this ratio for such lenses will therefore very approximately be in the ratio of the distance of the image from the collar in millimetres to 160.*

Magnification of the Microscope.—In order that the image formed by the objective shall be formed in the plane which is 160 mm. above its collar, it is only necessary that the microscope shall be focused with an eyepiece so mounted that its collar has its under face in the plane which is conjugate to the plane in which it is assumed that its image is to be formed, i.e. conjugate to the plane which is 250 mm. from its upper focal plane. All eyepieces so mounted will be parfocal.

With the draw-tube at 160 mm. the combined magnification of the instrument will then accurately be the product of the two magnifications so defined.

Thus if these magnifications are engraved on the objective and eyepiece respectively, the user can at once obtain the total magnification as a simple product.

Effect of Objective Changer.—If an objective changer is being used, the draw-tube must be shortened to correct for the extra length added by the changer. To make this correction easy, it would be well to make the increase in length caused by the changer uniform, say 15 mm., so that it shall only be necessary to set the draw-tube at 145 mm. to retain the correct magnification. A changer which does not cause the standard increase in length should have its increase in length engraved upon it.

Projection of a Real Image.—When a microscope is being used to give a real image projected upon a screen instead of the virtual one seen when looking through the instrument, it is obvious that the conjugate plane in the eyepiece to this image will no longer be in the plane of the collar of the eyepiece and the magnification would therefore no longer be the same product. But if the microscope is first focused on the usual virtual image and then, without altering either the coarse or fine adjustment, is re-focused on to the screen by lengthening the draw-tube, the new conjugate plane will still be at

* To take a numerical example: suppose the upper focal plane of a 2-mm. objective to be 10 mm. below the collar and the image to be at 180 mm. instead of 160 mm. from the collar. Then the given magnifying power would be $(160+10)$ divided by $2=170\div 2=85$, and the new power should be $(180+10)/2=95$. The result obtained by multiplying 85 by the ratio $180/160$ is 95.62, and is therefore correct within a half of 1 p.c.

160 mm. from the collar of the objective, so that the initial magnification by the objective will remain that engraved upon it. If, in addition, the screen is placed 250 mm. from the upper focal plane of the eyepiece, the magnification of the eyepiece will also still be that engraved on it, and the total magnification will still be the product as before. Should the screen not be at 250 mm. from the eyepiece, its new magnification will be simply proportional to the ratio of the new distance to the standard 250 mm., the distance being measured from the upper focal plane (which is not far from the eyering; in fact, if f is the focal length of the eyepiece in millimetres, the eyering is approximately $f^2/160$ mm. above the upper focal plane; i.e. about 4 mm. for a $\times 0.10$ eyepiece and about 1 mm. for $\times 0.5$ eyepiece).

The eyepieces will not be parfocal when used for projection, and to keep the magnification correct the re-focusing on changing eyepieces should be done with the drawtube. (The final critical focusing can, of course, be obtained with the fine adjustment, since the slight additional movement will not appreciably affect the size of the image.)

Recommendations.—Thus we arrive at the following recommendations :

1. All objectives should have engraved on them the magnifications they give when the image is formed at 160 mm. from the upper surface of the collar of the mount of the objective.

This magnification—since few objectives can be made accurately to their nominal powers—should be actually measured by the use of two micro-meters, one on the stage and the other mounted in a plane which is 160 mm. from the collar and which is viewed by a positive eyepiece.

2. All eyepieces should have engraved upon them the magnification they give when the image is formed 250 mm. from the upper focal plane of the eyepiece.

3. All eyepieces should have collars of which the under surface is conjugate to the above image plane (the plane 250 mm. from the upper focal plane, measured downwards, i.e. the virtual image plane).

4. All objective changers should either add exactly 15 mm. to the tube length or have the amount they add to the tube length engraved upon them.

APPENDIX 2.—SWIFT AND HIS MICROSCOPES.

James Powell Swift (1829–1906) was apprenticed along with E. R. Watts to Swaine, a surveying instrument maker. At the end of his apprenticeship Swift went to Andrew Ross and became his chief mechanic at the same time as J. H. Dallmeyer was his chief lens-hand. In the early 'fifties Swift left Ross and started on his own as a microscope maker. In 1880 he invented the diagonal rack and applied it to his "Challenge" microscope, in which microscope he not only also introduced his "Climax" fine adjustment with its side lever, but also re-introduced the Jackson grooves in the Lister limb for the slides for the body and the substage ploughed at one setting of the

casting in the machine. Then in 1886 he applied the side lever to produce the movement of the body as a whole instead of the nose-piece only.

In his "New Histological and Petrological" microscope of 1894 he first made the saw-cut for the better adjustment of the slide fitting and also made use of the differential screw for the fine adjustment. This was described in 1894 ⁵⁴ with a direct screw and in March of the same year with the differential screw.⁵⁵ This later microscope had a stand with four legs, of which the back two were joined together at their upper ends and mounted to swing about a pin there; this gave it increased stability over the three-legged pattern. In the same model a small square bracket was mounted at the back of the fine-adjustment screw, by the tightening of which the screw could be pressed against one side of the nut in which it worked, and thus any backlash could be taken up. This same stand appears to have been the first microscope designed for progressive "building up," as the purchaser could add and fit for himself ⁵⁶: (1) a racked centring substage; (2) a mechanical stage and sliding bar; (3) an additional drawtube with rack; (4) a Wenham binocular body.

I have to thank Mr. Chetwynd Palmer, who has kindly given me much of the above information and references.

APPENDIX 3.—NOTE ON THE FIRMS OF POWELL AND ROSS.

The decline of the amateur demand for large and expensive instruments of the Powell, Ross, and similar instruments, such as the Watson "Van Heurck" microscope, from about the beginning of the present century brought about the end of the above two famous names as microscope makers.

Tom Powell, the son of the first Hugh Powell, had always apparently had few if any men to work for him, and had largely made the instruments with his name upon them by his own hands. He was by now a man of over sixty and he made no attempt to compete with the new demand. At this time he would take an order for a microscope to be delivered in perhaps a year or even longer. He gave up his shop in Euston Road in 1906 and moved to Emsdale, Greenham Road, Muswell Hill, where he continued to do a little repair work till his death in 1925.⁵⁷

The firm of Ross was concentrating on the production of rapid photographic lenses and on the manufacture of binoculars, and it decided not to attempt to compete with the new demand for a cheap microscope. So somewhere about the same date (1906 or so) it stopped making microscopes, referring enquirers to Swift, who also finished a few partly made instruments for Ross.

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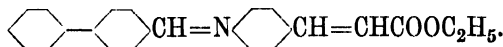
II.—LIQUID CRYSTALS AND ANISOTROPIC SOLUTIONS. 532.785.

By A. S. C. LAWRENCE, Ph.D.
(Laboratory of Colloid Science, Cambridge.)

(Read February 16th, 1937.)

FOUR PLATES AND NINE TEXT-FIGURES.

At one time crystals were tacitly regarded as solid and solutions as invariably isotropic mechanically and optically.* The first idea seemed to break down when Lehmann observed the peculiar behaviour of ammonium oleate, which is semi-liquid while preserving some of the regularity of form and structure of an orthodox crystal.† In 1889 he observed that cholesterol benzoate formed an optically anisotropic liquid mesoform.‡ Since then many hundreds of substances have been found to pass on heating from crystalline solid to liquid crystal and, then, at a higher temperature, to isotropic liquid. Of all the organic substances known, not more than about 0.4 p.c. show the phenomenon. Some of these substances pass through more than one liquid crystalline stage, as many as five "melting-points" having been observed for a single substance, the ethyl ester of para-phenyl-benzalamino-cinnamic acid :



Friedel's name "mesoform" is the best one for these intermediate stages, which have also been called "liquid crystals," "crystalline liquids," and "anisotropic melts."

At this time there was already some evidence for the mechanical anomaly of certain solutions,§ but recognition of this phenomenon as a quite common characteristic of colloidal solutions was delayed until recent years.

We now recognize the following stages from solid to liquid. For a single substance heated we have :

1. Normal solid crystal.
2. Soft crystalline.
3. Liquid crystalline—two stages :
 - (a) smectic : i.e. solid in two dimensions and liquid in one ;
 - (b) nematic : i.e. solid in one dimension and liquid in two.
4. Isotropic liquid.

* Liquid showing viscous anomaly and flow birefringence are usually isotropic at rest.

† "Flüssiger Kristallen."

‡ M. 9, 436.

§ Barus, *Amer. J. Science*, 45, 87, 1893. Schwedoff, *Congr. Int. de Phys.*, 1, 478, 1900.

Class 4 might be further subdivided into glasses and liquids, but the distinction is somewhat arbitrary and ill-defined.

For solutions we have, in the direction of increasing concentration by cooling, salting out, etc. :

1. Isotropic liquid.
2. Isotropic liquid of high but Newtonian viscosity.
3. Liquids showing anomalous viscosity and/or flow birefringence.
4. Pastes, doughs, emulsions, etc.
5. Dry solute which may be normally crystalline solid or amorphous.

In general, substances do not pass through the intermediate mesoforms, but occasionally more than one mesoform appears. One substance was observed to pass directly from nematic to vapour phase ; this was *di-anisal-benzidine*.

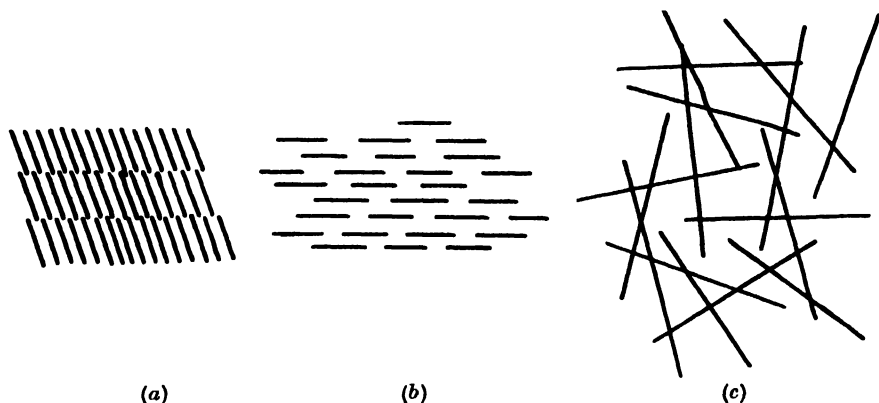


FIG. 1.—Arrangement of anisodimensional particles.

- (a) Smectic layer structure, two-dimensional orientation.
- (b) Nematic one-dimensional orientation.
- (c) Random arrangement in isotropic gel.

In most cases where mesoforms have been observed, the substance is distinguished by the markedly anisodimensional form of its molecules or micelles. Pastes and similar systems are exceptional in this respect, but show their mechanical anomalies at high concentrations only. The reason for this difference will become clear later. The possibilities of arrangement of rod-shaped or elongated plate-shaped particles are simple (fig. 1) :

(a) is the smectic layer structure : that is, solid in the plane of the layers and liquid normally to them so that flow occurs in sheets. The relation of this structure to the normal layer lattice of fatty substances is obvious ;

(b) is the nematic structure rod-shaped molecules orientated parallel to each other, but with no other regular periodicity ;

(c) is the form of arrangement of anisodimensional particles in a colloidal solution in the absence of any orientating force. The particles are, of course, several hundred times as long as those in (1) and (2). This arrangement can become rigid if there is a definite binding at the points of contact. The

result is a gel. Whether elastic or liquid, the system is optically isotropic. When streaming converts a colloidal system into an anisotropic and mechanically anomalous one, the arrangement of particles is being converted into something like (2), except that in nematic substances swarms exist in the isotropic melt, whereas in the streaming colloidal solution the particles are distributed uniformly through the liquid dispersion medium. It may be noted that colloidal solutions do occasionally deposit a sort of "swarm." Freundlich has noted their appearance on old sols of vanadium pentoxide and ferric oxide. He has named them "tactoids." Fig. 2 shows their appearance between crossed nicols.

LIQUID CRYSTALS.

The formation of mesoforms is rare. It seems necessary that the molecule should have an elongated form and complex composition. Where benzene rings are present, the *para* substituted compounds are liquid crystalline, the corresponding *ortho* and *meta* substances being distinguished only by a strong tendency to super-cooling.* It is obviously necessary that the forces binding the molecules in the mesoform should be specially balanced, otherwise the substance will be fully crystalline and will melt normally. Hydrocarbons give no mesoforms. Polar groups must be present; but their polarity must not be too great. The fatty acids give no mesoform, but their thalious soaps do. *Para*-azoxy-benzoic and cinnamic acids are very insoluble, infusible substances. Their esters are smectic. It may be noted that the azoxy group is particularly active in promoting the phenomenon. Several $\text{—N}=\text{C(H)—}$ groups in a suitably shaped molecule are also efficient.

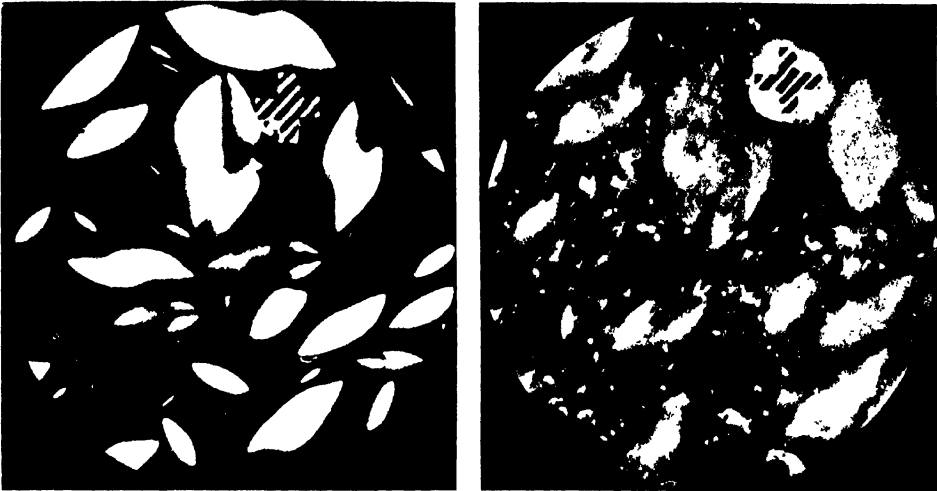
THE SMECTIC MESOFORM †

Typical substances are :

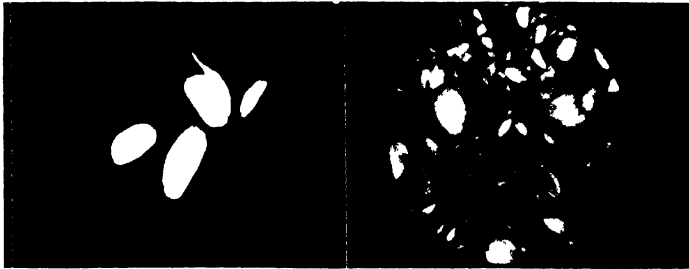
		Trs.	M.p.
thalious stearate	$\text{CH}_3(\text{CH}_2)_{16}\text{COO}^{\text{tl}}$	118° C.	163° C.
ethyl <i>p</i> -azoxy-benzoate	$\text{C}_2\text{H}_5\text{OOC} \begin{array}{c} \diagup \quad \diagdown \\ \text{C}_6\text{H}_4 \end{array} \text{N}=\text{N} \begin{array}{c} \diagdown \quad \diagup \\ \text{C}_6\text{H}_4 \end{array} \text{COOC}_2\text{H}_5$	114° C.	120° C.
ethyl <i>p</i> -azoxy-cinnamate	$\text{C}_2\text{H}_5\text{OOCH}=\text{CH} \begin{array}{c} \diagup \quad \diagdown \\ \text{C}_6\text{H}_4 \end{array} \text{N}=\text{N} \begin{array}{c} \diagdown \quad \diagup \\ \text{C}_6\text{H}_4 \end{array} \text{CH}=\text{CHCOOC}_2\text{H}_5$	140° C.	250° C.

* Vorländer Ber., 543, 2261, 1921, and *Krist. flüssige Substanzen*, 1908. The chemistry of liquid crystalline substances has been worked out systematically by Vorländer, and we are indebted to him for almost all the work done in that direction.

† *Smectic* is stated in the text-books and by Friedel, who coined the name, to mean "soap-like," from the Greek *σμω* and *σμεγμα*, "soap." The Greeks, however, did not know soap, and the word means "grease" or "slime." The error was due to the first "liquid crystal" observed being a soap-ammonium oleate—and to the belief that the Na soaps are also smectic. The evidence that the soaps are smectic (in the sense of the substances described above) is very weak. Either they are truly smectic but with a very large viscosity between layers or they are plastic without any layer structure. This latter appears the more probable alternative, although we do not know the cause of the plasticity.



(a)



(b)

FIG. 2. - Tactoids.

(a) Vanadium pentoxide (pointed ends). (b) Ferric oxide (rounded ends).



FIG. 11. *p*-azoxy-phenetole, showing solids forming from nematic mesoform, metastable on right and stable on left.



FIG. 18. -Lenticular bubbles in gel.

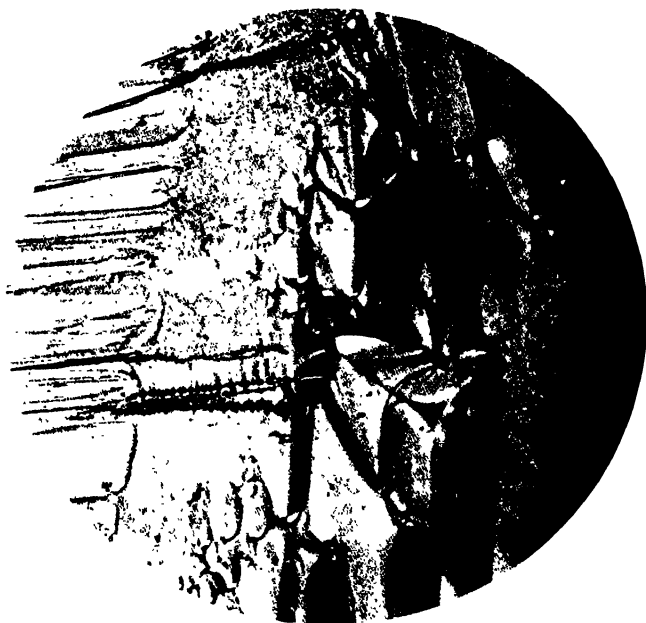
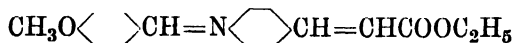


FIG. 3. Smectic mesoform (ethyl *p*-azoxy-benzoate), showing (from left to right) : Crystalline solid; smectic, as pseudomorph of solid, smectic, focal conic structure; isotropic liquid.



FIG. 4.--Smectic mesoform separating from isotropic liquid as "Batonnets."

ethyl anisal-amino-cinnamate



114° to
nema-
tic
113° to
liq.

107° C.

When the smectic mesoform is reached by cautious heating of the solid, it is seen as a number of flakes which take their shape and orientation from the solid crystalline plates from which they were melted. When, however, the mesoform is reached from the isotropic liquid state or when the smectic flakes are heated a little above their temperature of transition from solid to smectic, a quite different and characteristic structure is seen. This is the arrangement of focal conics. Fig. 3 shows all the stages. The preparation of ethyl *p*-azoxy-benzoate is being heated by a hot wire on the right-hand side of the preparation so that there is a temperature gradient falling from right to left across the field. Nicols are crossed so that the isotropic liquid appears dark. As temperature falls, non-spherical droplets of the smectic mesoform appear. These have been called *bâtonnets*, from their characteristic shape, fig. 4. As the substance is all transformed to the smectic state, the focal conic structure appears. In this preparation there is also seen a region which is smectic but which has not been heated high enough to pass into the focal conic structure, although a line of little focal conics can be seen along a line of discontinuity. It is also seen how lines of discontinuity in the solid are preserved in the liquid crystal. This preparation is enclosed beneath a cover-glass. If not so covered, other phenomena due to the layer structure can be seen. Flow takes place in sheets. These are called Grandjean's terraces, after their first observer. They are shown particularly well by the thalious soaps : fig. 5. The solid soap is heated by the hot wire until smectic and rubbed a little on the slide to increase parallel orientation of the sheets. On raising or lowering the temperature slightly the substance now flows in sheets in a most remarkable manner. A rather similar phenomenon is seen when a droplet is cooled, a stepped surface being formed on the smectic drop : fig. 6.

The focal conic structure is very important as a means of detecting the smectic mesoform, but, from the point of view of its structure, a secondary phenomenon. It has its origin in the lack of common orientation of the smectic sheets as they form. Sir William Bragg has described very clearly how Dupin's cyclides are the solid geometrical form in which the smectic sheets of different orientations can accommodate themselves to each other with the least amount of strain * (fig. 7). Friedel showed that the molecular axes lay along lines drawn from an ellipse to a hyperbola which has its plane at right angles to that of the ellipse and passes through one of its foci. The focus of the hyperbola lies on the ellipse. In fig. 3 the ellipses and hyperbolæ can be seen clearly (as optic axes). The arrangement of Dupin's

* Roy. Inst. Proc., 1934, 28, 57, and Farad. Soc. Trans., 1933, 29, 1056.

cyclides is the only one in which straight lines drawn from any point on either curve to all points on the other curve form cones of revolution. All such straight lines are cut by the cyclides at right angles. The cyclides are regularly spaced, and we therefore have an arrangement of layers, the molecular axes lying along the lines. The arrangement still involves some strain. This depends upon the rate at which the optic axis changes in a direction at right angles to it. As Friedel says, "the focal cones are the axes of the unrolling of the structure around which the optic axes diverge." The focal conics are visible where the optic orientation is varying rapidly.

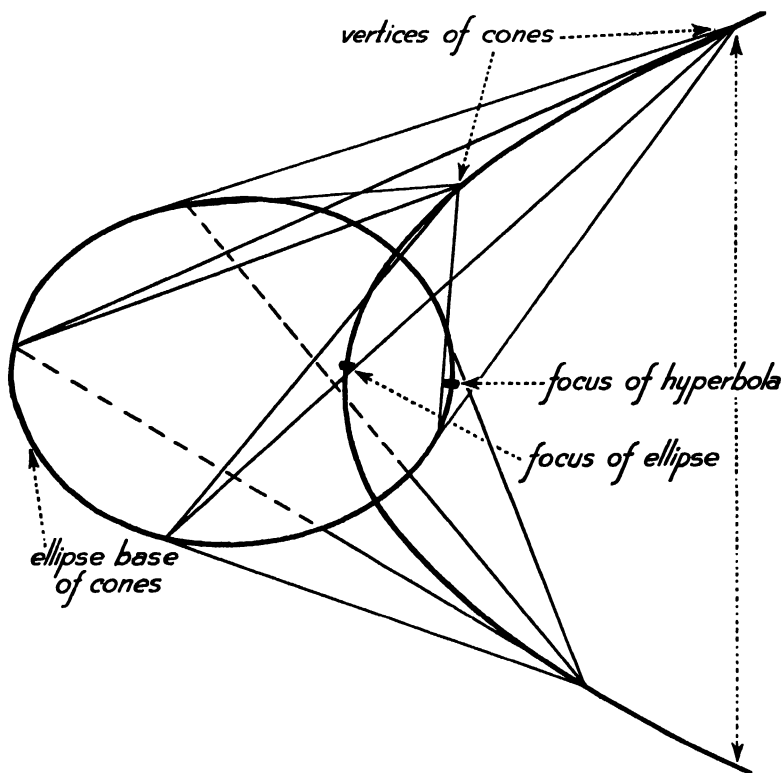


FIG. 7.—Focal conic structure.

We may note that the orthodox description of the smectic mesoform as being a structure of layers, solid in their planes but liquid at right angles to them, is not strictly accurate. If the smectic mesoform flowed in monomolecular sheets, these would be invisible owing to their small thickness. The sheets which we see are many layers of molecules thick. Just above their transition point, they do not even flow into the focal conic structure. These facts may be explained by postulating a small rigidity at right angles to the sheets. This rigidity decreases with rise of temperature, but does not

disappear until the substance melts to isotropic liquid. The re-arrangement to focal conic structure may be regarded as a surface energy phenomenon—the surface tension is not equal, of course, along all three axes. The substance tends to reduce its total surface energy, but just above the transition temperature from solid to smectic the rigidity is still too large for any movement. The terraces are formed when the cumulative contraction of a number of superposed layers is sufficient to overcome the rigidity.

Solidification of a smectic mesoform to the corresponding solid layer lattice involves only a small change of internal energy and the latent heat is small. The smectic layer structure provides a regular periodicity normal to the layers so that this mesoform gives an X-ray diffraction pattern from which the layer thickness can be calculated. This confirms the chemist's idea that the molecules are arranged in sheets in which the long dimension of the molecules may be either normal or inclined to the sheets.

Herrmann found by X-ray examination that thallos stearate molecules were tilted at an angle of 47° with the smectic planes. Most substances have their molecules with the long axis perpendicular to the planes in the smectic state and tilted in the solid.*

The smectic mesoform is not orientated by an electric or magnetic field. There are not any marked effects due to adhesion to their glass support. This is not surprising, since the surface of the sheets, which would be the adhering surface, is the plane of fluidity, slip, and minimum adhesion.

NEMATIC MESOFORM.

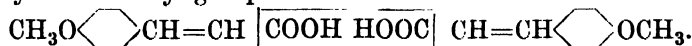
Typical substances passing through a nematic mesoform are :

		Trs.	M.p.
<i>p</i> -azoxy-anisole	$\text{CH}_3\text{O} \langle \rangle \text{N} \begin{array}{c} \diagup \diagdown \\ \diagdown \diagup \end{array} \text{N} \langle \rangle \text{OCH}_3$	93.5° C.	149.6° C.
<i>p</i> -azoxy-phenetole	$\text{C}_2\text{H}_5 \langle \rangle \text{N} \begin{array}{c} \diagup \diagdown \\ \diagdown \diagup \end{array} \text{N} \langle \rangle \text{OCH}_3$	135° C.	165° C.
anisal-azine	$\text{CH}_3\text{O} \langle \rangle \text{CH}=\text{N}-\text{N}=\text{CH} \langle \rangle \text{OCH}_3$	160° C.	180° C.
<i>p</i> -methoxy-cinnamic acid	$\text{CH}_3\text{O} \langle \rangle \text{CH}=\text{CHCOOH}$		
<i>di</i> -benzylidene-benzidine	$\langle \rangle \text{CH}=\text{N} \langle \rangle \text{—} \langle \rangle \text{N}=\text{CH} \langle \rangle$		

Ethylanisal-amino-cinnamate,



is both smectic and nematic. It is obvious that it contains groups to which the two states can be attributed. At first sight *p*-methoxy-cinnamic acid might be expected to be smectic, but in the melt the molecules are associated in pairs by the carboxyl groups :



* K. Herrmann and A. H. Krummacker, *Z. Krist.*, **81**, 317, 1931.

The double molecule is then of the type required to give the nematic mesoform rather than smectic.

It was first recorded that azoxy-phenetol and azoxy-anisol melted first to opaque liquid, and then, also at a sharp temperature, to a clear one. The significance of this observation was not realized then, but these substances are now the characteristic examples of the nematic mesoform. The name (Greek *νημα*—a thread) was given by Friedel because of the curly black lines which are usually seen when this mesophase is examined in polarized light under the microscope. Fig. 8 shows these.* The lines are, of course, optic axes. The most striking feature of the nematic mesoform is its violent agitation. An optic axis is not, however, disturbed by this, which shows that this internal flow is subject to orientating restriction. It may be noted here that a nematic melt is opaque from the same cause as is a lump of marble or other micro-crystalline material. The anisotropic liquid is not optically homogeneous. Application of an electric or magnetic field gives the nematic surface a common orientation and the substance then becomes clear, provided that orientating effects at the walls of the container are avoided.

It is in these three properties that the nematic mesoform differs most markedly from the smectic: much greater fluidity; ease of orientation by electric and magnetic fields; and the very marked orientating effects of solid surfaces.

When the nematic mesoform is reached from isotropic liquid, it first appears in drops which are spherical, in contradistinction to the smectic *bâtonnets*. Fig. 9 shows these anisotropic drops. It can be seen that they have a common orientation. Note that they are anisotropic, whereas the nematic phase in bulk is not. This means some orientation in the spherulites imposed by growth as droplets. No Grandjean's terraces nor *Gouttes à gradins* are formed in the nematic mesoform.

The viscosity of *p*-azoxy-anisole and *p*-azoxy-phenetole in the nematic state has been observed and anomalies found.† In the first case, the viscosity of the nematic stage is less than that of the liquid just above the melting-point. There is a marked increase over a small temperature range at the melting-point (fig. 10). The actual viscosity, however, both in this region and in the nematic range, depends upon the rate of shear, being very large at small rates, curve (c), and decreasing at higher rates of flow, curve (b). This anomaly is quite parallel to that of other anomalous systems which will be described in the last part of this paper. The anomaly in the nematic range is similar to the anomaly shown by emulsions and is due to the fact that part of the work applied is used in distorting the spherical droplets, work being done against interfacial surface tension. The smaller the rate of shear, the larger is the proportion of the total work used in this way, and

* Reproduced from *Proc. Roy. Inst. (loc. cit., p. 7)* by kind permission of Sir William Bragg.

† W. Ostwald, *Farad. Soc. Trans.*, 1933, 1002; A. S. C. Lawrence, *loc. cit.*, 1080.



FIG. 5. Thallous soap, showing layer structure ("Grandjean's terraces").



FIG. 6.--Edge of a drop of smectic substance showing terraced surface "Goutte a gradina."



FIG. 8. Nematic mesoform, showing from left to right : crystalline solid; nematic isotropic liquid.



FIG. 9. Separation of nematic mesoform from isotropic liquid.

therefore the smaller the rate of flow and the greater the apparent viscosity, calculated on the assumption that all the work is used in causing flow. At the melting-point, the second anomaly is parallel to that shown by partially miscible liquids at their critical solution temperature and by gases in the region of their critical temperatures. This high apparent viscosity is due to excessive turbulence.

Nematic mesoforms are orientated by electric fields much too small to have any effect upon single molecules. This is because the common orientation of the molecules in a swarm intensifies the molecular dissymmetry. The electric moment of a swarm is 10^5 times that of a single molecule. The diamagnetism of nematic mesoforms leads to a similar value for their size.

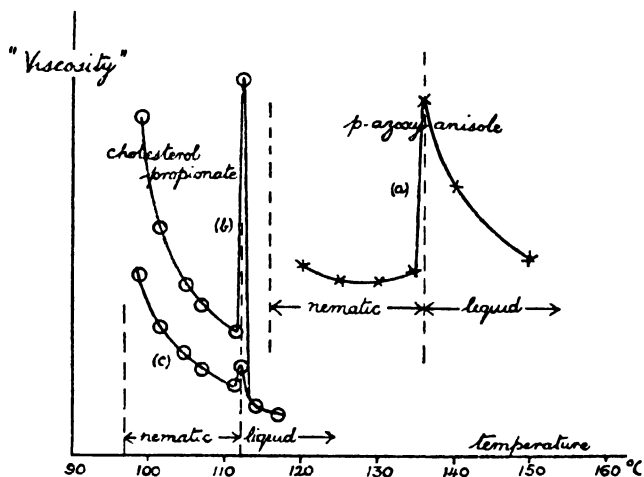


Fig. 10.—Anomalous viscosity of nematic mesoforms.

On heating, orientation decreases somewhat and the diamagnetism falls slightly. At the melting-point to isotropic liquid it drops abruptly to zero. The swarms show large dielectric anisotropy (Kerr effect), which means that in the orientated swarms the induced and permanent dipole moments are at right angles. The axis of the swarm is the direction of least magnetism and smallest electrical polarizability. The relaxation time is 10^{-5} secs. for nematic swarms, whereas it is 10^{-11} for molecules.

The nematic mesoform shows remarkable adhesion to glass and other surfaces. When formed by warming the solid substance, the appearance of the nematic substance is determined by the orientated patches at the glass surfaces, and so looks like Pl. I., fig. 11. This induced orientation persists as far into the mesoform as 0.1 mm. In suitable preparations the cover-glass can be twisted a little and the flakes adhering to top and bottom glass surfaces separated. Sometimes the adhering surface layer is visible above the melting-point of the interior of the preparation to isotropic liquid. On

melting and recooling flakes appear where they were before melting, but repetition of this procedure several times breaks them up and makes the appearance more confused each time.

CHOLESTERIC SUBSTANCES

Friedel has segregated these substances on the somewhat inadequate evidence of their optical peculiarities. Apart from cholesterol compounds, a few other substances have been reported to show this strange optical anomaly: e.g. amyl-cyano-benzal-amino-cinnamate. On cooling a melt of one of these substances, a mesomorph is formed (which is, in the higher fatty acid esters of cholesterol, definitely smectic) showing brilliant iridescent colours as the temperature falls to the solidifying point. This light is circularly polarized. It may be formally ascribed to interference at surfaces of regularly spaced layers 500 to 5000 molecules thick: as if reflection of light circularly polarized in one direction was not reversed, as ordinarily, on reflection, and so caused interference. In this state these substances show enormous optical rotations, of the order of hundreds of turns per mm.

DETECTION OF MECHANICAL ANOMALIES IN SOLUTIONS.

The viscosity of a normal liquid is independent of the rate of shear. It is convenient to use the hybrid name "anomalous viscosity" for cases where the apparent viscosity, calculated by application of the usual equations, increases with decreasing rate of shear. Fig. 12 shows the sort of result given by plotting apparent viscosity against rate of shear. Anomaly can be detected by flow viscometers. The Poiseuille equation: $\tau = \frac{P\pi r^4}{8l\eta}$, where

P is pressure head, r radius of tube, l its length and η the viscosity, assumes that all the pressure applied causes shear of liquid with zero rigidity. In anomalous systems, some of the stress is used in other ways. The amount so used is an increasingly large fraction of the total shear as this is reduced. Hence the rise of apparent η with fall of stress. A much more convenient method of detecting anomaly is the coaxial cylinder viscometer. This consists of two cylinders, the outer one being rotated and the inner one hanging from a torsion wire. The torque of the inner cylinder, when the outer one is rotated, is measured by a mirror and scale. The instrument can be calibrated by using a liquid of known viscosity, or it can be used as an absolute method if the constants of the torsion wire and the apparatus are known. The instrument is particularly useful for anomalous systems because of the ease with which measurements can be made at very low rates of shear. Nevertheless flow viscometers are usually used, in particular the Ostwald instrument. This is most unsuitable for anomalous systems, since the rate of flow is not under control, nor is it constant during a run. Ostwald has

devised a modified form in which the pressure head can be varied, but even so the flow viscometer is inferior to the co-axial cylinder instrument for anomalous systems for hydrodynamical reasons.*

If the Poiseuille equation does not hold good for a system, it is because the flow is not Newtonian; that is, the linear velocity does not increase as the square of the distance from the wall of the tube, as it does in normal liquids, but in some more complex manner. The velocity distribution across the tube is therefore the essential factor. This has been measured by several methods, and it was hoped that a relation could be found connecting the linear velocity with distance from the wall by means of which a modified Poiseuille equation could be deduced for anomalous systems. The results

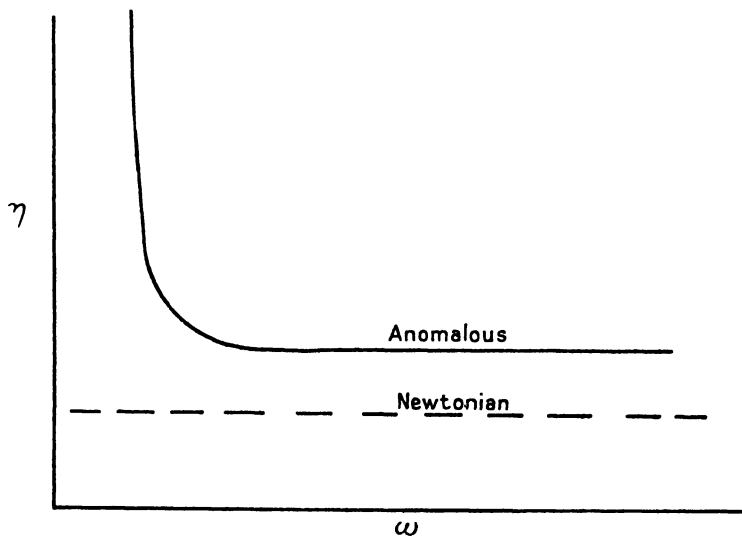


FIG. 12.—Anomalous viscosity.

are, however, too complex. Measurements were made by the writer by the following method: † twin supplies of solution were connected to the flow tube by a specially designed two-way stopcock. One supply was coloured by addition of a small amount of red dye. The colourless solution was flowed through the tube and then the stopcock was turned over rapidly so that the coloured supply flowed in under the same pressure head. Its profile was photographed as it travelled along through the colourless solution. At the moment when the stopcock is turned, the surface of the coloured supply is a plane across the tube. As it travels along, it is drawn out into a paraboloid in the case of water or ordinary solutions; and into less simple forms

* See the very important papers by Guth and others of the Vienna school on the hydrodynamics of anomalous flow: *Koll. Zeit.*, 1937.

† *Roy. Soc. Proc.*, 148, 59, 1935.

in anomalous solutions. Fig. 13 shows the results obtained by plotting the linear displacements at known time intervals against the square of the width of the coloured cone. For normal flow, a straight line is obtained, indicating parabolic velocity distribution. If the flow is anomalous, there is a falling off of the linear velocity towards the centre of the tube. The

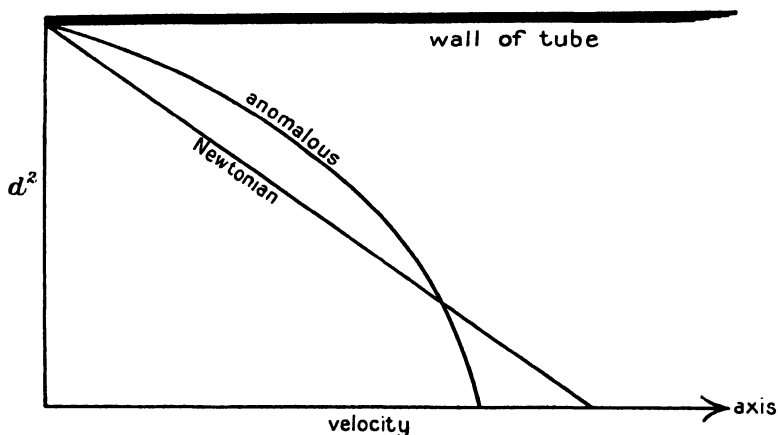


FIG. 13.—Velocity distribution in flow viscometer.

manner in which it falls off depends upon the rate of shear and upon the nature of the system. The results can be further analysed by calculating from these curves “apparent viscosities.” For Newtonian liquids, the viscosity coefficient is equal to the reciprocal of the slope corrected by a

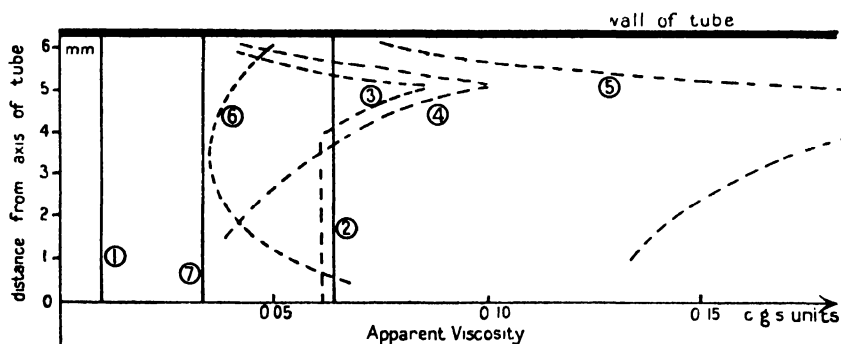


FIG. 14.—Anomalous viscosity in flow viscometer.

factor for the dimensions of the tube and for the pressure head. Fig. 14 shows the apparent viscosities obtained in this way for normal and anomalous liquids, plotted against distance from the wall of the tube. In normal liquids the viscosity does not vary with rate of shear so that it is uniform across the tube. With anomalous systems it is seen to be otherwise. In

general, viscosity is low near to the wall where the rate of shear is highest. For this reason, adhesion to the wall is seldom found even in systems so concentrated that they travel as plugs, all the shearing being in a thin annulus at the wall. Similar results have been obtained by other methods of measuring velocity distribution such as :

Anemometer : Richardson and Tyler : *Proc. Phys. Soc.*, **44**, 142, 1933.

Pitot tubes : Kroepelin : *Zeit. Physik. Chem. A.*, **149**, 291, 1930.

Particles in solution : Pichot and Dupin, *Comptes Rendus*, **192**, 1079, 1931.

McBain's centrifugal method—time taken for ball to move from point p_1 to p_2 in tube rotated at various speeds : *J. Rheology*, **3**, 439, 1932.

All viscosity measurements assume that the liquid is in steady stream-line flow. If, however, the velocity is too great, turbulence occurs. Reynolds has shown that this sets in at a velocity given by the equation : *

$$R = \frac{vd\Delta}{\eta}$$

where R is a number called the Reynolds number, d is the diameter of the tube, η the viscosity of the liquid, Δ its density, and v is the *mean* velocity ; that is, the volume efflux divided by the cross-sectional area of the tube. For normal liquids R is about 1400, but in solutions which show anomalous viscosity, R is considerably lower.†

OPTICAL ANISOTROPY IN SOLUTIONS.

When sols such as myosin, vanadium pentoxide, and mercury sulphosalicylic acid are examined in convergent polarized light, they are isotropic at rest, but in flow behave as birefringent uniaxial crystals. The usual brush is seen in convergent light, and from its position with respect to the planes of polarization of the nicols, the orientation of the optic axes of the particles in the sol may be deduced. It does not follow, of course, that the optic axis of the particle should also be its geometric axis, but these are sufficiently close in many cases for the orientation of the particles in the streaming sol to be studied by means of its optical properties. There are at least two possibilities in colloidal systems : strain birefringence and orientation birefringence. The former has been discussed by Stokes as follows (fig. 15) : at a point O (in a coaxial cylinder viscometer), the forces acting are a pressure PP and a tension SS . It is obvious that the resultant double refraction will have its optic axis along SS , since both forces taken separately produce this result. The angle of isocline is therefore 45° . Angle of isocline α is defined as the smaller of the two angles which the optic axis of the orientated particle makes with the radius drawn through it. It is also the

* Collected Papers, pp. 51, 105, 524.

† Andrade and Lewis, *Koll. Zeit.*, **38**, 261, 1926.

larger angle between the brushes and planes of polarization. For the study of individual particles it is necessary to work in solutions sufficiently dilute to preclude the possibility of strain birefringence, and we are concerned only with orientation effects. In the coaxial cylinder viscometer the orientating effect of flow is equivalent to a tension T superposed upon the ordinary shearing force S (fig. 16). The directions of principal stress, therefore, make an angle with radius and perpendicular to the radius so that :

$$\tan 2\alpha = 2S/T$$

α must therefore be less than 45° . $45^\circ - \alpha$ is the angle of isocline. This must increase with T .

We cannot evaluate T , but the equation shows that progressive orientation of particles in the sol will bring about an increase of the angle of isocline. This treatment applies to gels under strain, but not to more dilute systems in which the particles are free kinetic units. Kuhn has made an attempt to calculate the stresses on such particles.*

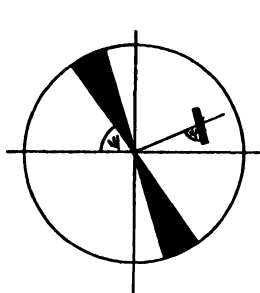


FIG. 15.—Strain birefringence.

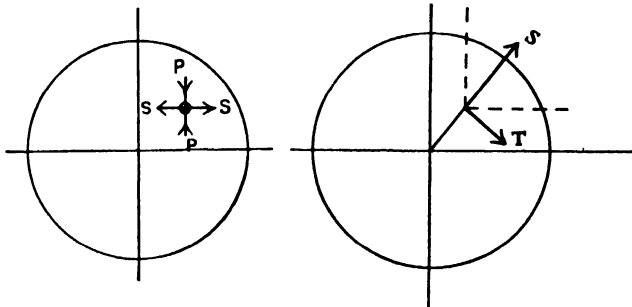


FIG. 16.—Streaming birefringence.

CAUSES OF ANISOTROPY IN SOLUTIONS.

In all colloidal systems we have to take into account the effects of Brownian motion. This is not only a disorientating effect in streaming but also initiates precessional movements of anisodimensional particles which complicate any theoretical treatment of streaming orientation. We must also realize that we have to deal with a range of particles whose length/breadth ratio may vary over an enormous range—from 1 to 10^3 or even more ; and also with a range of physical properties which profoundly affect the results. At one end of the scale—the upper limit of size, which we meet in hydrophobic systems such as V_2O_5 —we are dealing with rigid crystalline rods which are anisodimensional as a peculiar crystal habit and whose length/breadth ratio is not likely to be extremely large, but which will remain constant under working conditions. At the other end we have chemically linear polymer-molecules whose chemical length/breadth ratio may be 10^3

* *Zeit. physik.*

or even more, but which are only a few atoms wide and which are not rigid rods ; nor even geometrically linear. Energy considerations show that the stable form of such a particle will be an aperiodic coil. Its length/breadth ratio will, however, still be large, even though its geometrical length may be only the square root of the chemical length. These considerations apply to naturally occurring polymer-molecules such as the proteins, cellulose, rubber, etc., and to the synthetic polymers. Kinetic considerations show that the particle will undergo random oscillations, not always as a whole, but with different parts of the large particle in independent Brownian movements. Mark has pointed out that as temperature increases so will the disordering effects increase, so that at a higher temperature more work will be required to stretch rubber and to bring the irregularly coiled particles into regular linear alignment. Hence the increase of elasticity of rubber with temperature. This idea may be extended to solutions, and it is clear that increase of kinetic energy of particles with increase of temperature will mean increased interference with the ordinary hydrodynamical flow. Whether the actual measured viscosity of the solution increases or not depends upon whether the increase of viscosity due to the particles is greater or less than the normal decrease of viscosity of the solvent over the temperature range. The more flexible a particle is, the more nearly would it approximate to a sphere when its kinetic energy was increased.

Both naturally occurring and synthetic large molecules are very long chemically and very thin, since both are formed by processes of linear polymerization. Examination of these systems for both mechanical and optical anomalies is complicated by their variable and irregular form. Under shear, there will be not only orientation but also uncoiling of particles, which will increase their length and complicate their interference with the hydrodynamical flow. Since uncoiling involves orientation, it will also therefore increase the birefringence. Viscous anomaly will still be present, since part of the shearing force applied is used to stretch the particles and not all to shearing the solution as a whole. When the particle lies across the velocity gradient it will be orientated and elongated. When its axis approaches the stream lines, it will " shut up " again until random kinetic movement brings it across the velocity gradient once more.

STAUDINGER'S WORK.

Staudinger has prepared large numbers of polymer-molecules, some of very great molecular weight, and has used viscosity as a criterion of particle length. A simple molecule of the type $\textcircled{\text{A}} = \textcircled{\text{B}}$, in which A and B are groups which interact, will polymerize linearly to form very long, thin chain molecules whose length is limited only by kinetic and steric factors during the polymerization. Staudinger assumed that a polymer-molecule will rotate and fill an effective volume, which is a flat disc, equal to $\pi \left(\frac{l}{2}\right)^2 \theta$,

where l is the length and θ the thickness. A solution containing n particles will therefore have a total effective volume of solute of $n \cdot \pi \left(\frac{l}{2}\right)^2 \theta$. When this is equal to the total volume of the solution, the particles will begin to interfere with each other's free rotation if any more are added. The viscosity will therefore begin to increase more rapidly with further increase of concentration. This critical concentration has been used by Staudinger to determine the length of polymers. In general, polymers do not form gels, probably because the rigidity of the individual particles is insufficient.

From the previous discussion it is difficult to believe that Staudinger's simple picture is strictly accurate. His measurements were made by the flow viscometer, so that there was a very high rate of shear near to the wall.

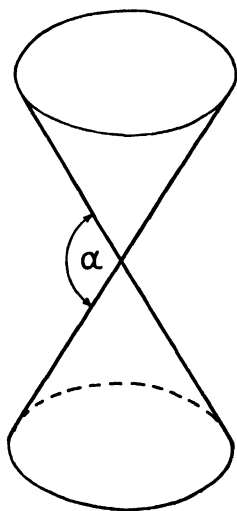


FIG. 17.—Precessional motion of anisodimensional particle in flow.

His assumption of uncoiled particles does not seem probable. His results have been, in some cases, verified by independent methods, but it must be remembered that if the form and size of the particle are such as to cause viscous peculiarities, they will also cause anomaly in other methods, such as centrifugal sedimentation.

The form of an anisodimensional particle in random kinetic motion plus shear is a double solid cone, fig. 17. Under shear its motion will be an irregular precessional one, the rate of rotation being greatest when the particle is normal to the velocity gradient. At high rates of shear the angle α will approach 180° , so that we approach a physical picture of Staudinger's assumption. This, however, applies in a flow viscometer only to an annular region where the velocity gradient is large.

The general picture, however, is reasonably clear. Fig. 1, c, is the distribution of colloid particles in the absence of orientating disturbances.

The length of the particles as shown is not the chemical length of flexible particles, but something less. Maximum interference with flow occurs when we have this random distribution, but flow causes orientation according to the rate of shear, and as the particles become orientated along the stream lines so does their interference disappear. At the same time they now cause streaming birefringence, which therefore reaches its maximum conditions when dissipation of energy is least. Increase of temperature increases disorientating effects, so that at higher temperature higher rate of shear is required to produce a given streaming birefringence or reduction of apparent viscosity.*

GELS.

Gelation is closely related to anomalous viscosity, but clearly involves some additional factor, since not all anomalous sols gelate, although all gelating sols show anomalous viscosity. This factor is interlocking of the gel particles into a rigid three-dimensional structure. Rigidity of a gel requires these bonds to take the strain. Rate of relaxation is a measure of their strength. In silicic acid we have a three-dimensional polymerization, in gelatin, a crystallization of large particles containing a number of polar groups. Alumina gels are weaker and the bonds between the particles are easily modified by electrolytes. The characteristics of a gel are that it should be rigid, isotropic, optically empty in the sense that no single particles can be detected ultra-microscopically, although a Faraday-Tyndall cone can usually be seen; generally the gel contains only a small amount of solute—often less than 1 p.c. It does not seem to be a necessary criterion that the gel should be permanently stable, since many gels are known which crystallize on standing.† However, the majority of gels are permanently stable. They show no birefringence other than occasional strain birefringence in more concentrated specimens in which shrinkage has caused it. Incidentally it may be noted here that many gels exhibit this shrinkage on long standing although the phenomenon has not received attention. If a gel is kept in a cylindrical vessel so that the depth of gel is considerably greater than its diameter, it shrinks slowly and the surface is drawn in, but after some weeks the rigidity of the gel prevents further convexity; as the shrinkage continues lenticular bubbles, which are empty, form lower down in the gel (Pl. I., fig. 18). This is important, since it suggests slow particle growth on standing. If the dispersed phase is insoluble, there seems to be no reason why the particles should not aggregate slowly, the sole difference between this and any other system of fine particles being that the process is slowed up enormously by the rigidity of the system.

The facts are explained by assuming that the gel is a system of anisodimensional particles arranged at random as in fig. 3 and interlocked at

* Since this lecture all these effects have been observed quantitatively in several sols containing rigid crystallite rods by Mr. Robinson in this laboratory.

† E.g. camphoryl-phenyl-thio-semicarbazide in organic non-polar solvents and calcium acetate and sodium benzoate in alcohol/water mixtures.

points of contact. If their length/breadth ratio is considerable, a small concentration of solute can cause the system to form a rigid gel, provided the individual particles have a certain rigidity themselves. This loose meshwork structure also explains the other characteristics of gels: that liquids can diffuse freely through them and that the sol-gel change involves no change in physical properties such as osmotic pressure, electrical conductivity, light-scattering, etc. It is also clear that a sol containing only just enough solute to form a self-supporting gel will not set immediately, since under conditions of preparation—stirring, etc.—there will not be the ideally random orientation of particles and gelation will not occur until this has been achieved on standing while Brownian motion brings about this result. This brings us to another peculiarity of certain gels—thixotropy. This name has been given to the peculiar behaviour of gels which can be converted to liquid of low viscosity by shaking. Then, on standing for a short time, they re-set to gel. The change can be repeated any number of times. It is shown well by lyophobic systems, such as vanadium pentoxide, ferric oxide, and alumina. It is clear enough what is happening. On shaking, orientation of groups of molecules occurs and the random orientation necessary for gelation is lost. This orientation is easily shown by the development of local birefringences on shaking or stirring sols of vanadium pentoxide. On standing, the random orientation is restored by Brownian agitation. On the kinetic consideration put forward earlier, it can be seen that this disorientating effect is greater at higher temperatures. The gel should therefore re-set more rapidly at higher temperature so long as its dispersion does not vary with temperature. This has been observed in sols of ferric oxide. The temperature effect follows the Arrhenius relation, giving an energy of activation of 28,000 cal.

Gelation requires supersaturation of the solution and that the particles should separate in anisodimensional form. This can be achieved in several ways according to the nature of the system. In lyophobic sols, by addition of electrolyte in amount insufficient for coagulation, or by removal of stabilizing ions by dialysis; in lyophilic systems, it may occur as a crystallization in the necessary fibrous habit. This occurs in the soaps in both aqueous and paraffin solution. In other lyophilic systems the normal form in which the colloid separates from solution is not fully crystalline and is of the form required for gel structure. This applies to gelatin and agar and similar substances. It will be noted that the substances forming permanently stable gels at any temperature are often those which are not fully crystalline at that temperature. Nevertheless gelation of a substance like gelatin is of the nature of a crystallization in the sense that the primary particles in the solution aggregate by their polar groups to form larger ones. The difference between gelatin and a simple crystalloid is that the primary units are themselves of such irregular shape and constitution that they cannot act as regular bricks to build up a crystal, but hook on to each other where adhering groups happen to touch.

ANOMALOUS SYSTEMS OF ISODIMENSIONAL PARTICLES.

Vanadium pentoxide forms long rods, ferric oxide elongated plates, alumina rods. Thoria forms approximately spherical particles. Its sols show no anomalies even up to a content of 60 p.c. If alumina is formed by Crum Brown's method—boiling the acetate for some hours with several lots of water to hydrolyse and remove the acetate group—the particles are formed slowly and have the crystalline rod shape necessary for gelation. If formed by peptization of the precipitated hydroxide, they are spherical and the sol shows neither viscous anomalies nor streaming birefringence, whereas the Crum Brown sol does.

Many concentrated pastes of isodimensional particles show rigidity, e.g. mud pies, clay pastes, paints. Here close packing is essential and the rigidity is caused by adhesion of the surfaces in contact. This may be altered by application of an external electric field or by addition of suitable polar substances and the rigidity lost. Thixotropy cannot occur in such systems.

A final case of anomalous viscosity is provided by emulsions. Here the anomaly is due to distortion of the spherical oil droplets by shear and work is done against interfacial tension. At low rates of shear this is a large proportion of the total work supplied, so that the viscosity, calculated by the usual equations which assume that all the work is used in shearing the system, appears abnormally high and decreases with increasing rate of shear as the proportion of work actually used in shearing the system becomes a greater proportion of the total work supplied. This is similar to the nematic mesoform. The anomaly is independent of the viscosity of the oil forming the droplets.

CONCLUSION.

In conclusion, we have seen that the phenomena described are the result of increase of complexity and size of particles from complex molecules to huge polymer-molecules and finally to colloid particles which are the kinetic units in colloidal solutions corresponding with molecules or ions in normal solutions. There is now continuity from large molecules to the huge naturally occurring ones, since polymers have filled the gap previously existing between the largest molecules and naturally occurring colloids. We have seen the extreme importance of shape and of distribution of active groups on large anisodimensional particles, whether in molecules forming liquid crystals or in colloid particles forming gels. We are beginning to learn something of the deviations from the ideal chemical form of giant molecules under various kinetic and mechanical conditions and, therefore, of the *actual* shape of particles causing anomalies. What still remains to be done is to find the influence of these factors and anomalies on living matter.*

* F. Rinne, *Faraday Soc. Trans.*, 1933, 1016.

Not only do these peculiar properties provide a means of studying substances separated from living matter,* but, what is much more fundamental, they determine the mechanical behaviour of these substances in their natural environment and provide a mechanism for the orientation which precedes vital change.

Fig. 9 is reproduced here by kind permission of Sir William Bragg and the Managers of the Royal Institution, and I am indebted to Prof. H. Freundlich for fig. 2.

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* Von Muralet and Edsall, *J. Biol. Chem.*, 1930, 289.

III.—AN EFFICIENT TECHNIQUE FOR CLEANING DIATOMS.

By N. INGRAM HENDEY. F.J.S., F.R.M.S.

(Read March 16th, 1938.)

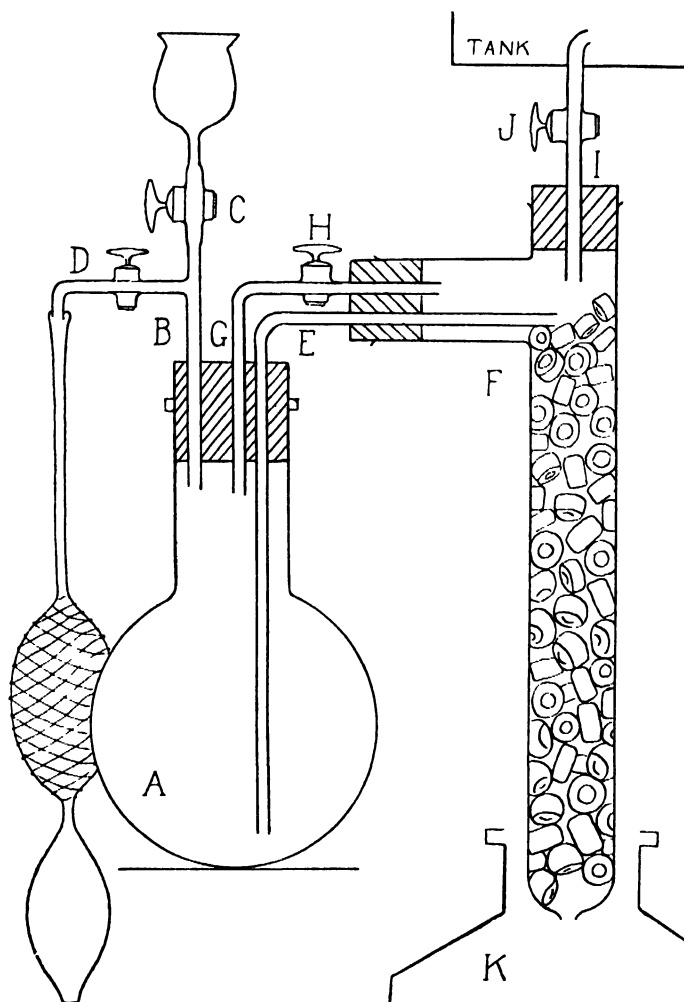
ONE TEXT-FIGURE.

It is well known that the systematic classification of diatoms is based upon the characters of the siliceous frustules and that before these can be interpreted clearly the diatoms have to be cleaned. The cleaning involves the total removal of the coleoderm and the protoplasmic contents of the cells. Several methods are available for this purpose, but the most usual depends upon use of mineral acids and an effective bleaching agent. It is not within the purpose of this paper to compare or contrast the various methods used, for in my opinion none yields such good results as a mixture of nitric acid and sulphuric acid to destroy the organic matter, and nascent oxygen, formed by the reduction of potassium chlorate for the bleaching. The reactions involved necessitate the use of a fume chamber or that the operation be carried out in some place where a current of air can carry away the gases evolved. As the former is not always available and the latter sometimes inconvenient, the apparatus described here may be of some use to practical diatomists. To those who are unfamiliar with cleaning diatoms it must be stressed that the following directions must be interpreted in the widest manner, and that experience alone is the best guide. The dimensions and quantities given can be modified to suit requirements.

The apparatus consists of a 250-c.c. bolt-head flask A, of Pyrex glass, fitted with a rubber cork through which pass three tubes. The one B, surmounted by a thistle funnel and controlled by a glass tap C, has a side tube fitted with a tap D, to which is attached a bellows. The second E, passing to within 2 cm. of the bottom of the flask, and the third G, passing just within the flask, are bent in the manner shown and connected to the tube F. Tube G is controlled by tap H. Tube F is 20 mm. diam. and 20-25 cm. in length, and provided with a side arm fitted with a rubber cork through which pass tubes E and G. The lower end of tube F is constricted to a 4-mm. opening and enters a waste bottle or sink K. Tube F is filled with glass beads approximately 1 cm. diam., and the upper end is fitted with a cork through which passes a short tube I, controlled by a tap J, which is connected to a tank of suitable capacity (500-1000 c.c.). The tank is filled with a solution of sodium sulphite and sodium carbonate, 5 gm. of each to 100 c.c. of water. Tubes B, E, G, and I are 4 mm. bore, so also is the bore of the

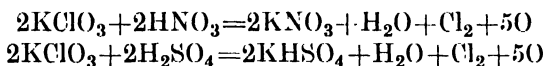
tap C. Taps D, H, and J are 2 mm. bore. A gauze is placed beneath the flask and the whole apparatus is supported upon a retort stand.

A quantity of diatom material, about 1 gm. or as much as will lie upon a florin, is placed in the flask, and the flask is connected with the rest of the apparatus. 10 c.c. of nitric acid are added through the thistle funnel,



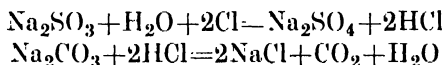
and the mixture allowed to stand for two or three minutes, when 5 c.c. of sulphuric acid are added. All taps *except H* are closed. Gentle heat is applied to the flask, either by a Bunsen burner or a spirit lamp, until the acid begins to boil. It is seldom necessary to boil the acid for more than one minute if freshly collected diatoms are being treated, but fossil material may require gentle boiling for 3-10 minutes. When sufficient heat has been

applied, the flask is allowed to cool. One gm. of finely powdered potassium chlorate is stirred with 10 c.c. of water, and introduced into the flask through the thistle funnel, and tap C is closed. Complex interactions take place depending on the temperature and the proportions of the acids present, in which the potassium chlorate is reduced and chlorine is evolved. The following formulæ probably represent the reactions :



with $2\text{HClO}_3 = \text{H}_2\text{O} + \text{Cl}_2 + 5\text{O}$ as an intermediate reaction.

Other reactions take place, and nitrosyl chloride may be formed. The interaction is usually vigorous and extreme caution should be exercised. At this point, tap J is turned to allow the sodium sulphite-carbonate solution to drip slowly into the scrapper, F in the diagram. The excess of the gases evolved passes up the tubes E and G into the scrapper F', where it interacts with the alkaline sulphite solution according to the following formulæ :



The products of this interaction are allowed to run into the waste bottle K. When the interactions in the flask appear to have ceased, tap D is opened and the bellows are gently operated to exhaust the flask of chlorine. Tap C of the thistle funnel is opened, and water is added in separate portions of approximately 20 c.c. The contents of the flask are gently agitated by rocking the whole apparatus. The addition of water is continued until it reaches half-way up the neck of the flask. *Taps C and H are closed.* The apparatus is allowed to stand until the diatoms have settled. The time required will vary with the material treated. Tap D is opened and the bellows are gently operated. The increased pressure thus created within the flask drives the water and the residue of the acids along E, through F', into K, leaving the diatoms in the bottom of the flask. Taps C and H are opened, and the flask is again filled with water. The diatoms are allowed to settle ; taps C and H are closed ; and the water is removed from the flask by operating the bellows in the manner described. The diatoms may be freed completely from acid by repeated washings without removing them from the flask, or the final washings may be made with a centrifuge.

Cautions.—Potassium chlorate reacts with explosive violence with hot sulphuric acid and a gauze should be used between the flame and the flask. Care should be taken to see that the contents of the flask have cooled before the potassium chlorate is added. Tap H must be left open throughout the acid treatment of the diatoms and while the water necessary for the washing is added, as it is the only outlet for gas if the lower end of tube E becomes immersed, but must be *closed* before operating the bellows to remove the water and acids from the flask. The level of the water in the waste bottle K should not be allowed to reach the lower end of the scrapper F'. This will prevent any "sucking back" of water into the flask.

To avoid corrosion of the rubber corks by the acid, ground-glass stoppers with the tubes passing through may be used. If this modification is adopted, the glass stoppers should be slightly smeared with phosphoric acid (88–90 p.c.) to prevent them locking in the necks of the flask and the scrapper.

The complete apparatus may be obtained from C. L. Muller, 6, Parton Street, London, W.C.1.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

Stain for the Gonococcus and Meningococcus.—B. R. SANDIFORD ("An Improved Method of Staining for the Demonstration of *Neisseria* in Cellular Exudates," *J. Path. & Bact.*, 1937, **45**, 467–8). Films are first stained by the ordinary Gram stain up to the end of decolorization, and are then counterstained for two minutes in the following solution, which is a modified Unna-Pappenheim stain: methyl green, 0.15 g.; pyronin, 0.50 g.; alcohol (95 p.c.), 5 c.c.; glycerol, 20 c.c.; aqueous phenol (2 p.c.), up to 100 c.c. After staining, wash lightly, blot, and dry. The counterstain keeps well for two or three months at temperatures up to 80° or 90° F.

R. T. H.

Direct Staining of Virus Elementary Bodies.—M. GUTSTEIN ("New Direct Staining Methods for Elementary Bodies," *J. Path. & Bact.*, 1937, **45**, 313–14). It is found that the elementary bodies of viruses can be stained with basic dyes directly, without mordanting, provided alkaline solutions are used. Films of the material are prepared on perfectly clean slides, and are dried in the air or in an incubator. If much protein is present, the film is rinsed in saline and then in distilled water. Fix films in methyl alcohol for half an hour or more. Two staining methods are given: (1) Methyl violet method. Two solutions are prepared: (a) 1 p.c. methyl violet in distilled water and (b) 2 p.c. NaHCO_3 . Place the prepared slide in a Petri dish, mix equal parts of the two solutions, filter at once on to the slide, cover dish with lid, and incubate at 37° C. for 20–30 minutes. Rinse in distilled water, dry, and mount in cedar oil or liquid paraffin. The elementary bodies are stained distinctly and intensely a light violet colour. (2) Victoria blue method. Two solutions are prepared: (a) Victoria blue 4 R, 1.0; alcohol, 10.0; distilled water, 90.0; (b) 0.02 p.c. KOH. Place the slide, film down, in a Petri dish, supporting it on capillary tubing. Mix equal parts of the two solutions, filter at once, run the filtrate under the slide, cover with lid, and allow to stand at room temperature overnight. Then rinse with distilled water, dry, and mount in neutral balsam or paraffin. The elementary bodies are stained dark blue.

R. T. H.

Mallory's Connective Tissue Stain Modified.—G. CROSSMON ("A Modification of Mallory's Connective Tissue Stain with a Discussion of the Principles Involved," *Anat. Rec.*, 1937, **69**, 33–8). Owing to the fact that in the original technique the phosphomolybdic acid is combined with aniline blue and orange G, it was impossible to control microscopically the decolorization of the collagen fibres stained with acid fuchsin. This method removes these difficulties. Tissues are fixed in Zenker's fluid, cut in paraffin, and after removing the bichloride sections

are brought down to water and stained either in Mayer's acid hæmalum or in Weigert's iron hæmatoxylin till nuclei are overstained. After washing in running tap-water for 10 minutes sections are stained for one or more minutes in acid fuchsin (Nat. Aniline Co.) 1.0 gm., orange G (Nat. Aniline Co.) 0.4 gm., distilled water 300 c.c., thymol crystals 0.2 gm., glacial acetic acid 3.0 c.c. Rinse in distilled water; decolorize in 1 p.c. aqueous phosphotungstic acid solution under the microscope till collagen tissue is colourless. The decolorizing ability of the acid solution is soon lost. Rinse quickly in distilled water and stain for five or more minutes in either light green 1 gm., glacial acetic acid 1 c.c., distilled water 100 c.c., or aniline blue 2 gm., glacial acetic acid 2 c.c., distilled water 100 c.c. Rinse quickly in distilled water. Differentiate in 1 p.c. acetic acid under the microscope, rinse quickly in distilled water, and pass directly to absolute alcohol, xylol, and mount in balsam. G. M. F.

An Embedding Plate.—J. R. KING ("A New Home-made Embedding Plate," *Stain Technol.*, 1938, **13**, 23–4, 1 pl.). This plate eliminates the necessity of moving the embedding dish for cooling by the presence of circulating water in the trays, thus rapidly cooling the paraffin after the specimens are arranged. Two copper trays are provided 5 inches long, 4 inches wide, and 1 inch deep, separated by a space of $\frac{1}{2}$ inch from one another and a space of 2 inches above the brass base. Water is brought from a faucet into the tray on one side and let out by a large outlet on the other. Heat for keeping the paraffin melted during the embedding is provided by a small heating unit which slides from one tray to the other on a track. The adherence of paraffin ribbons in hot weather to the paper on which they lie can be eliminated by the use of a large tray filled with ice and water, which keeps the glass plate over the tray cold and likewise the paper containing the ribbons. G. M. F.

Microincineration.—S. H. GAGE ("Apparatus and Methods for Micro-incineration," *Stain Technol.*, 1938, **13**, 25–36, 9 text-figs.). This general review describes the electric furnace originated by Policard and explains the method of preparation, the sectioning of objects for incineration, and finally the process itself. The microscopic outfit needed consists of an ordinary microscope with an Abbé or aplanatic substage condenser with central dark-stops of 10, 15, and 20 mm. for the different objectives. These range from 16 mm. to oil-immersions, the powers above 16 mm. having iris diaphragms to reduce the aperture to a suitable amount. It is a great advantage to have sections of an object incinerated and neighbouring sections stained and mounted for comparison, a dark-field and an ordinary bright-field microscope being arranged side by side. The method of calibrating the electric furnace is described. Microincineration was first described by Francois-Vincent Raspail (1833) in his "Nouveau système de chimie organique fondé sur des méthodes nouvelles d'observation," pp. 528 *et seq.* G. M. F.

Staining Mucous Cells.—R. G. BUSNEL ("Note relative aux techniques employées pour la recherche des cellules à mucus," *Bull. Histol. appl.*, 1937, **14**, 205–7). Instead of using carmine for the detection of mucous cells, the effect on sections of fish-gills and skin has been studied of metachromatic dyes such as thionin, toluidine blue, methylene blue, methylene violet, methylene azure. The following technique involves the use of toluidine blue. Fix in picro-formol, embed, section, and pass down to water; wash for 10 minutes in distilled water; dip for 1–2 minutes in 0.5 p.c. toluidine blue. Pass rapidly through absolute alcohol, clear, and mount. Mucous cells are violet against a dark-blue background. Cartilaginous tissues are also mauve and erythrocytes green. G. M. F.

Staining by Mordant Dyes specially by Alizarine-Hæmatoxylin Phosphotungstic Acid after Triple Mordanting.—A. CRÉTIN ("Note sur les colorations par des colorants-mordants spécialement par l'alisarine-hématoxyline phosphotungstique après mordaneage triple," *Bull. Histol. appl.*, 1937, **14**, 163-7). The following technique for staining bone is based on the principle of depositing lakes from two contrasting dyestuffs, following triple mordanting. The "fixative" consists of enough 40 p.c. formol added to 1 litre of commercial wood alcohol to obtain a concentration of 50 p.c. alcohol, saturated with picric acid. Sodium chloride 3 gm. and 250 c.c. of 15 p.c. trichloroacetic acid in the same alcohol are added. Tissues are fixed for four or five days and, if necessary, decalcified in 15 p.c. aqueous sodium hydrochloride containing 5 p.c. hydrochloric acid, before embedding in paraffin or celloidin. The following mordant is made up: 15 p.c. AlCl_3 150 c.c., 3 p.c. FeCl_3 , 25 c.c., distilled water 200 c.c., mixed, and 30 p.c. CaCl_2 450 c.c. is added and made up to 1 litre with distilled water. Before use this mordant is diluted 1:2 with distilled water and applied for 36 hours or more: sections are washed thoroughly in water and stained for from 1 to 24 hours in the following solution: 10 days-ripened 3 p.c. hæmatoxylin 100 c.c.: 10 p.c. alizarin red S 150 c.c., to every 25 c.c. of which immediately before use is added 1 c.c. of 10 p.c. phosphotungstic acid. The stain should be used not before 24 hours and not later than 8-10 days after preparation. Wash thoroughly in distilled water, several times in 95 p.c. alcohol, in dioxan and in tap-water. Dehydrate and mount. With hæmatoxylin the Ca-Al lake yields light blue to Prussian blue, the Fe-Al lake blue violet to violet, and the Fe-Ca lake violet black; with alizarin the colours produced are respectively orange red to bright red, dark orange, and reddish violet. G. M. F.

Staining Nerve Fibres with Silver.—F. O. FOLET ("Staining Nerve Fibres with Silver in Tissue fixed with Bouin's Fluid," *Stain Technol.*, 1938, **13**, 5-9, 1 pl.). Nerve fibres, in organs fixed with Bouin's fluid, are usually refractive to the Davenport silver technique. The axones, however, can be successfully stained if the sections, fixed to slides, are passed through xylol or absolute alcohol and then placed in concentrated pyridine for 1 hour. They are then rinsed in absolute alcohol, passed rapidly through ether-alcohol, and placed in a 2-4 p.c. ether alcohol solution of nitro-cellulose for 1-5 minutes, after which they are removed and given a thin coating of nitrocellulose. Slides are then placed in a solution of ammoniated alcohol (1 part 28 p.c. ammonium hydroxide and 99 parts of 80 p.c. alcohol) for 12-24 hours. From ammoniated alcohol they are rinsed very briefly in 80 p.c. and transferred to a 40 p.c. aqueous solution of silver nitrate for 6-8 hours at 37.5° C. From the aqueous silver bath the slides are placed directly into Davenport's acidified alcoholic solution of silver nitrate (20 gm. of silver nitrate in 20 c.c. of distilled water, 0.1 to 0.5 c.c. normal nitric acid, and 95 p.c. alcohol up to 100 c.c.) at room temperature for 16-24 hours. The slides are then rinsed in 95 p.c. alcohol and placed in a 5-8 p.c. alcoholic solution of pyrogalllic acid (pyrogalllic acid 8 gm., formaldehyde 5 c.c., 95 p.c. alcohol 95 c.c.) to which has been added 1 c.c. of dilute yellow Karo syrup (Karo and distilled water, equal parts). Following reduction slides are rinsed in 95 p.c. alcohol and placed in running tap-water for 1-3 minutes, sections are toned in a 0.2 p.c. aqueous solution of neutral gold chloride for 10 minutes, washed in running tap-water, and placed in a 5 p.c. aqueous solution of sodium thiosulphate for 3-5 minutes. After washing in tap-water the coating of nitrocellulose is removed by passing slides through 75, 95, and 100 p.c. alcohol and two changes of acetone, absolute alcohol, xylol, and mounted in dammar. G. M. F.

A Differential Stain for the Anterior Pituitary of Mammals.—A. B. DAWSON and H. B. FRIEDGOOD ("Differentiation of Two Classes of Acidophiles in the Anterior Pituitary of the Female Rabbit and Cat," *Stain Technol.*, 1938, 13, 17–21). A differential stain for the anterior pituitary of mammals based on Heidenhain's "azan" modification of Mallory's connective tissue stain is described. Tissue is fixed for 24 hours in a saturated solution of corrosive sublimate in physiological saline (90 parts) and formalin (10 parts), and washed directly in 70 p.c. alcohol for 48 hours. Sections are treated on the slide with a 3 p.c. solution of potassium bichromate for 12 hours. Sections are stained in a 0.2 p.c. solution of azocarmine (Grübler) in 1 p.c. acetic acid at 55° C. for 1 hour: allow to cool. Differentiation is carried out under the microscope with 0.1 p.c. aniline oil in 95 p.c. alcohol till the carmine cells alone remain deep red. If the differentiation is slow a few drops of distilled water may be added to the alcohol. Rinse with acid alcohol (95 p.c. alcohol with 1 p.c. acetic acid), then with distilled water. Transfer to 5 p.c. phosphotungstic acid for 2 hours. Counterstain in orange G with methyl blue or aniline blue for 12–36 hours, depending on the freshness of the stain. Rinse with distilled water and examine under the microscope. If staining is insufficient replace in the stain; if satisfactory, pass directly to 95 p.c. alcohol, complete dehydration, clear, and mount in balsam. G. M. F.

A Comparison of Dehydrating and Cleaning Agents.—P. RALPH ("A Comparative Study of Some Dehydration and Cleaning Agents," *Stain Technol.*, 1938, 13, 9–15). Of dehydrating agents dioxan, isobutyl alcohol, tertiary butyl alcohol were compared as dehydrants. Slow dioxan is the best method of dehydration. Bouin's fixative produces less hardening, shrinkage, and distortion than other fixatives, such as Zenker formol and 10 p.c. neutral formalin. All the picric acid need not be removed from tissues to be embedded in paraffin. Tissue blocks 4 mm. thick may be dehydrated and impregnated with paraffin by slow dioxan in 13 hours, fast dioxan in 10 hours, and ethyl alcohol-chloroform in 17 hours, without incurring distortion due to rapidity of dehydration and infiltration. G. M. F.

The Fixation and Staining of Glycogen.—A. L. SCHABADASCH ("Morphology of Glycogen Distribution and Transformations. I. Principles of Fixation and Staining of Glycogen for Micro and Macroscopic Study," *Bull. Biol. Med. exper. de l'U.R.S.S.*, 1937, 4, 13–16, 2 text-figs.). A 7-shaped cannula is inserted into the veins and sodium chloride (0.65–0.9 p.c.) and sodium fluoride up to 0.1 p.c. are introduced in sufficient quantity to expel the main volume of the blood. This is immediately followed by the injection of the fixative consisting of alcohol 96 p.c. 55 gm., calcium picrate 35 gm. (prepared in advance), monochloroacetic acid 5 gm., formol (4 p.c.) 5 gm. (added before the injection). 10 to 30 minutes after the injection tissues are removed and fixed for from 6 to 8 hours, washed in 96 p.c. alcohol, and mounted in celloidin or celloidin-paraffin in the usual way. Sections brought down to water are treated with 4 p.c. chromic acid for from 60 to 120 minutes, washed in distilled water, and treated with fuchsin sulphuric acid. G. M. F.

Silver Impregnation of Reticulum.—G. GÖMÖRI ("Silver Impregnation of Reticulum in Paraffin Sections," *Amer. J. Path.*, 1937, 13, 993–1001). Paraffin sections are passed through xylol, two changes of alcohol and washed under the tap; oxidized with a 0.5–1 p.c. solution of potassium permanganate for 1–2 minutes, rinsed in water, and decolorized with a 1–3 p.c. solution of potassium metabisulphite for 1 hour. Sections are washed under the tap for several minutes, then sensitized in a 2 p.c. solution of iron ammonium sulphate in distilled water for 1 minute,

washed under the tap for a few minutes, then run through two changes of distilled water. Impregnation for 1 minute is carried out in the following solution. To a 10 p.c. silver nitrate solution add one-sixth to one-fourth its volume of a 10 p.c. solution of potassium hydroxide. Add strong ammonia water drop by drop, while shaking the container, till the precipitate is completely dissolved. Again add cautiously silver nitrate solution drop by drop till the resulting precipitate disappears on shaking. The solution is made up to twice its volume with distilled water. It can be kept stoppered for 2 days. Rinse in distilled water for 5–10 seconds. Reduce for 3 minutes in commercial formalin diluted with tap-water for 5–10 times its volume. Wash under the tap for a few minutes. Tone in a 0.1–0.2 p.c. solution of gold chloride for 10 minutes. Rinse in distilled water. Reduce, toning in a 1 to 3 p.c. solution of potassium metabisulphite for 1 minute. Fix in a 1–2 p.c. solution of sodium thiosulphate for 1 minute. Wash under the tap. Run through alcohols. Clear in xylol and mounted in balsam.

G. M. F.

Staining Spirochætes and Bacteria in Smears.—G. STEINER ("A New Method of Staining Spirochetes and Bacteria in Smears," *J. lab. clin. Med.*, 1937, **23**, 293–7, 2 text-figs.). The chemical processes used in the production of silvered mirrors have been adapted for staining spirochætes. The following solutions are prepared: (A) Silver nitrate (AgNO_3 crystals for analysis) 10 gm. are dissolved in 200 c.c. of distilled water, to which concentrated ammonia is added cautiously till the precipitate of silver oxide is dissolved. The solution is filtered and diluted with distilled water to 1000 c.c. (B) Silver nitrate, 2 gm., are dissolved in 1000 c.c. of boiling distilled water, then 1.65 gm. of finely powdered sodium potassium tartrate added and the whole boiled shortly till the white precipitate changes to grey, then filtered while hot. These solutions are kept separate in brown or amber bottles and do not deteriorate. Gum arabic 25 gm. are dissolved in 100 c.c. of hot distilled water, sterilized, and kept in the icebox. In the case of blood smears place air-dried well-fixed smears in dilute ammonia in a dish till the red colour of the hæmoglobin disappears. Wash thoroughly in distilled water. Mix 10 c.c. of solution A with 15 c.c. of solution B and 1 c.c. of the gum arabic solution. Spread the mixed solutions over the surface of the slide so that the smear and its surroundings are entirely covered. Allow to stand for 40–60 minutes. Wash in distilled water and dry in air. For smears it is advisable first to treat with a 2 p.c. solution of uranium nitrate for 2 minutes, wash thoroughly in distilled water and proceed with the mixed solutions as before.

G. M. F.

Spirochætes in Frozen Sections.—G. STEINER ("A Simple Method for Demonstration of Spirochetes in Frozen Sections," *J. lab. clin. Med.*, 1937, **23**, 315–6). Fix tissue thoroughly in 10 p.c. formalin for at least 12 hours or longer or for 8 hours in hot formalin at 55°–60° C. Wash in running tap-water, according to the size of the block for 20 minutes to half an hour. Cut frozen tissue at 25–30 μ ; wash twice in distilled water, then in absolute alcohol, and into the following mixture, 25 c.c. of 6 p.c. gum mastic in absolute alcohol, 10 c.c. of 4 p.c. uranium nitrate in absolute alcohol, 15 c.c. of absolute alcohol, filtered through a double, for 6–8 minutes. Wash sections in three or more changes of distilled water and stir till milky clouds or gummy strings have disappeared.

Transfer sections in 0.1–0.15 p.c. distilled water solution of silver nitrate and heat slowly in the open dish over the asbestos net till bubbles appear. When cool wash twice in distilled water, 95 p.c. alcohol for 1–2 minutes; transfer sections in 3 p.c. absolute alcoholic solution of gum mastic for 2 minutes. Again wash in

three or more changes of distilled water. To 100 c.c. of a 5 p.c. aqueous solution of hydroquinone 6 drops are added of 6 p.c. alcoholic gum mastic solution. The fluid has to be filtered through a double filter. Transfer sections to the filtered solution. Heat to just below boiling-point and allow sections to cool. Wash in distilled water, dehydrate, and mount in the usual way. G. M. F.

A Modified Silver Impregnation Technique.—H. GOODING and D. STEWART ("A New Modification of the Cajal Silver Impregnation Technique," *Lab. J.*, 1937, 7, 596-7). For demonstrating nerve fibres in the pulp and periodontal membrane of teeth the following modification of Cajal's silver impregnation technique is proposed. Fix in the usual way in 50 c.c. of 90 p.c. alcohol to which 4 drops of ammonia have been added for 48 hours; rinse in distilled water; place in 5 p.c. nitric acid for 48 hours. Wash for 24 hours in numerous changes of distilled water. Impregnate with 2 p.c. silver nitrate solution for 4-6 days. Reduce in pyrogallie acid 2 gm. in 98 c.c. of 5 p.c. formol for from 24 to 48 hours. With longer immersion the tissues tend to become dark orange, and this takes away from the contrast of the nerve fibres. The processes of impregnation and reduction are carried out in an incubator at 37° C. The specimens can be cut on a freezing microtome or embedded in paraffin. G. M. F.

Flattening Celloidin Sections.—J. T. HALL ("A Method for Flattening Celloidin Sections," *Lab. J.*, 1937, 7, 640-1). Before staining the section is transferred from 70 p.c. to 96 p.c. alcohol and left in the latter for 2-5 minutes, till the celloidin becomes slightly softened. The section is then removed by a section-lifter, avoiding curling or wrinkling, and placed in 96 p.c. alcohol. Shake the fluid gently and quickly remove section to 90 p.c. and then 70 p.c. alcohol. After washing in tap-water stain the section as usual: subsequently dehydrate in 70 p.c., 90 p.c., and 96 p.c. alcohols and clear in carbol xylol and xylol. Float section on to slide and blot gently with Whatman's No. 1 filter paper. Flood section with Canada balsam as rapidly as possible. G. M. F.

Arthropoda.

Arachnida.

Variation among the Eylais.—MÜNCHBERG ("Die Hydracarinenauna der Tümpel des Propstbruches bei Schloppe, zugleich ein Beitrag zur Variabilität der *Eylainae*," *Abh. Ber. Naturw. Abt. Grenzmark. Ges. Erforsch. Pflege d. Heimat.*, 1936, Jhg. XI, 1-8, 7 text-figs.). The author records some collections made in the neighbourhood of Schloppe and comments on the well-known variations which are to be found in the genus *Eylais*. BM/HNDH

Old and New World Arrenuri.—MÜNCHBERG ("Arrenurus planus Marsh. in U.S.A. und *A. papillator* (O. F. Müll.) in der Alten Welt, zwei ökologisch und morphologisch einander entsprechende Arten (Ordnung: Hydracarina)," *Arch. Hydrobiol.*, 1937, 31, 209-28, 7 text-figs.). The author received supplies of *A. planus* and hosts from America, and notwithstanding the long journey was able to cultivate this material in the Aquarium. His study of the phænology of *A. papillator* and *A. planus* shows considerable resemblance between the two. BM/HNDH

Parasitism by Arrenurus Larvæ.—MÜNCHBERG ("Über die an den *Culicinae* (Diptera) schmarotzenden *Arrenurus*-larven (*Hydracarina*), II," *Int. Rev. Hydrobiol.*, 1937, 34, 353-72, 6 text-figs.). The author describes the hosts which are parasitized by the *Arrenurus* larvæ and also deals with various stages in the development of the genus. BM/HNDH

Protozoa.

Deep Sea Cores.—J. A. CUSHMAN, L. G. HENBEST, and K. E. LOHMAN ("Notes on a Core-sample from the Atlantic Ocean Bottom South-east of New York City," *Bull. Geol. Soc. Amer.*, 1937, **48**, 1297–1360, pl. 1); same authors and others ("Preliminary Report on the North Atlantic Deep-sea Cores taken by the Geophysical Laboratory, Carnegie Institution," *Trans. Amer. Geophysical Union, Eighteenth Annual Meeting*, 1937, 224–6). These two brief reports mark the opening of a new chapter in oceanography. Until recently the sounding rod never penetrated more than a few inches into the sea-bottom, but the invention by Piggot of a new type of explosive sounding apparatus now provides cores up to nearly 3 metres in length. The first report deals with a trial core taken near the lower edge of the Continental slope in 1200 fathoms. The core was originally 162 cm. long by 48 mm. in diameter, shrinking after drying to 144 cm. and 35–40 mm., and presented an abrupt change in its lithological structure at 131 cm. from the top. The upper portion was a silty mud, the lower a clay-silt with sandy laminae. The diatoms represent a mixture of species now living in the region, with some fossils possibly derived from Miocene rocks on the mainland. No freshwater diatoms were found and their absence is inexplicable. The Foraminifera in the upper section of the core are species normally living in the region at present, and include no species characteristic of very cold waters, but those in the lower section represent a fauna of cold environment, such as is now found within the Arctic Circle. There are no distinctly Miocene or Pliocene species, and it may be concluded that the lower part of the core is of Pleistocene age.

The preliminary report deals with eleven cores taken between the Newfoundland Banks and the Irish Coast, in depths ranging between 700–2640 fathoms. All but three of the cores were over 2 metres in length, the longest being 2.93 metres. Two zones containing volcanic ash serve to correlate the cores, the upper zone being found in all the cores but one, which struck volcanic rock, the lower zone was reached in four western cores only. Between the ash zones, four other zones of distinctive lithology were found, characterized by relative abundance of sand and pebbles, a smaller percentage of calcium carbonate, and scarcity of Foraminifera and coccoliths. They are interpreted as glacial deposits formed during four separate glacial epochs. Between these glacial marine zones the sediments consist mainly of *Globigerina* ooze. The rate of deposition differs widely in the cores. Taking the uppermost glacial zone to represent the last glacial epoch, estimated at 20,000 years ago, the rate at Stns. 4.5.7 is approximately 20,000 years to the foot, but as the core at Stn. 3 did not penetrate to this zone, the rate must be more than ten times as rapid. The evidence furnished by the pelagic Foraminifera confirms the fact that at different levels in the cores warmer and colder water conditions alternated.

A. E.

Syrian Limestones.—F. R. S. HENSON ("Larger Foraminifera from Aintab, Turkish Syria," *Eclog. geol. Helvet.*, 1937, **30**, No. 1, 45–57, pls. 2–6, text-figs. 1–5). The disputed age of the foraminiferal limestones found at Aintab appears to have been settled by an examination of Blanckenhorn's original specimens now in the Hebrew University, Jerusalem. They prove to be from three different sources, Upper Eocene to Miocene in age. A new species of *Spiroclypeus*, *S. blanckenhorni*, and new variety *ornata*, are figured and described.

A. E.

Upper Cretaceous of Habana.—G. H. VOORWIJK ("Foraminifera from the Upper Cretaceous of Habana," *Proc. Kon. Akad. Wet.*, 1937, 40, No. 2, 190-8, pls. 1-3). An assembly of thirty-nine species, ten of which are not specifically identified, from typically Upper Cretaceous material collected to the South of Habana. The only large species found were *Meandropsina ruttleri*, *Camerina dickersoni*, *Vaughanina cubensis*, and *Orbitoides browni*, all of widespread distribution in Cuba. The smaller species include no less than fifteen species referred to *Gumbelina*, *Pseudotextularia*, *Planoglobulina*, and *Ventilabrella*, and it is observed that many of the species are below normal size. New species are *Gumbelina nuttalli* and *Globotruncana havanensis*. Plate 3 from photographs is good, the other plates are rather crude drawings, but sufficient for identification. A. E.

Spiral Chromosomes in Patellina.—J. LE 'ALVEZ ("Les chromosomes spiraux de la première mitose schizogonique du foraminifère *Patellina corrugata* Will.," *Comptes rendus*, 1937, 205, 1106-8, text-fig.). Describes a spiral spring arrangement of the chromosome threads in the first stage of mitosis in this species. Such a structure has not been observed previously in Protozoa, but is familiar in certain plants and has been recently noted in some animal cells. A. E.

Cretaceous Marginulinae.—J. A. CUSHMAN ("Some Notes on Cretaceous Species of *Marginulina*," *Cont. Cush. Lab. For. Res.*, 1937, No. 189, 91-9, pls. 13-14). The genus is represented by many species in the Cretaceous of Europe and America, and the earlier European specific names have been generally used by American authors. Comparison of the European types with American specimens, however, shows that many are not identical. *Hemicristellaria* and *Astacolus* are regarded as synonyms of *Marginulina* by the author, who defines that genus as coiled in the early stages, uncoiled in the adult, and not triangular in section. *Saracenaria* has a triangular section in the adult stage, but the two genera merge almost imperceptibly, as also does *Marginulina* with *Lenticulina* and *Dentalina* in opposite directions. Ten new species and two new varieties of *Marginulina* are described and admirably figured from photographs. A. E.

New Cretaceous Species.—J. A. CUSHMAN ("A Few New Species of American Cretaceous Foraminifera," *Cont. Cush. Lab. For. Res.*, 1937, No. 190, 100-5, pl. 15). Figures and descriptions of new forms in advance of publication of a monograph by the United States Geological Survey. *Quinqueloculina moremani*, *Massilina texasensis*, *Trochammina taylorana*, *Vaginulina selmaensis*, *V. suturalis*, *V. subgracilis*, *Nodosaria navarroana*, *Ellipsonodosaria pseudoscripta*, *Bolivinoidea austriana*, *B. texana*, *Bolivinita costifera*. The figures are excellent. A. E.

Eocene of Cuba.—J. A. CUSHMAN and PEDRO J. BERMUDEZ ("Additional New Species of Eocene Foraminifera from Cuba," *Cont. Cush. Lab. For. Res.*, 1937, No. 191, 106-110, pl. 16). Descriptions and figures of the following new forms: *Ammobaculites cubensis*, *A. penonensis*, *Haddonina cubensis*, *Ellipsonodosaria modesta* Bermudez n. var. *prolata*, *Uvigerina longa* and n. var. *denticosta*, *Amphistegina pinarensis*. The figures from photographs are good, but, contrary to the usual result, the smaller forms are better than the large species. A. E.

Holocene Foraminifera from County Antrim.—W. A. MACFADYEN ("On the Holocene Marine Fauna from the Implementiferous Deposits of Island Magee, County Antrim. Report on the Foraminifera," *Jour. Anim. Ecology*, 1937, 6, No. 1, 87-91). Samples of (1) subangular black gravel, (2) black sand, and (3) "Estuarine Clay" yielded in all 99 species and varieties of Foraminifera, (1)

yielding only twenty-seven forms as against sixty-eight and seventy-three for (2) and (3), the differences being due to the nature of the deposits. They represent a shallow-water fauna, all of which could no doubt be found living off the same coast to-day, and do not appear to show any evidence of altered climatic conditions. The typical boreal species *Elphidium arcicum*, already recorded from Glacial deposits in Northern Ireland, and which might have been expected if the sea had been appreciably cooler, was not found. There is nothing to suggest other than purely marine conditions of deposition. *Elphidium crispum* and other species intolerant of brackish water conditions are frequent to abundant, while the typical brackish water indicators, such as *Quinqueloculina fusca*, *Trochammina inflata*, and *T. macrescens*, are either absent or very rare. A. E.

Fossil Foraminifera from West Java.—H. YABE and K. ASANO ("Contribution to the Palaeontology of the Tertiary Formations of West Java. Part 1. Minute Foraminifera from the Neogene of West Java," *Science Rep. Tohoku Imp. University, Sendai, Japan, 2nd ser. (Geol.)*, 1937, **19**, No. 1, 90–126, pls. 17–19, text-figs. and 2 tables). A number of mine samples from various localities in Western Java include two definitely foraminiferous deposits, one of very late Tertiary age, probably Pliocene, the other Miocene with lower zones rich in *Operculina*, *Cyclocypeus annulatus*, and *Lepidocyclina* spp. The total number of species recorded is 199, of which ninety are from the Pliocene and forty-one from the Miocene, twenty-one species being common to both formations. Most of the Pliocene species are now living in the Indo-Pacific area and represent a shallow-water tropical fauna. New species from the Miocene are: *Elphidium javanum*, *Sigmoidella bakomensis*, *Bigenerina speciosa*, *Quinqueloculina javana*, *Robulus chitanii*, *R. bataviensis*, *R. costatus*, n.sub.sp. *bantarkasohensis*, *Nodosaria watasei*; and from the Pliocene: *Textularia bantamensis*, *Quinqueloculina reticulata* n.sub.sp. *chitanii*, *Triloculina tubiformis*, *Loxostoma indo-pacifica*, *Rotaliatina globosa*, *Massilina bantamensis*, *Buliminoides bantamensis*, *Virgulinea lunata*. There are many undetermined forms. The illustrations are adequate. A. E.

Bionomics of Hartmannella.—R. HEWITT ("The Natural Habitat and Distribution of *Hartmannella castellanii* (Douglas), a Reported Contaminant of Bacterial Cultures," *J. Parasit.*, 1937, **23**, 491–5, 5 figs.). *Hartmannella castellanii*, an amoeba originally found as a contaminant of bacterial cultures, has been isolated from the soil and from bacterial slime under damp logs. A description is given of cultures of the amoeba associated with bacteria and fungi, and of the viability of its cysts. C. A. H.

Amoebæ parasitizing Ciliates.—(1) R. M. STABLER and T. T. CHEN ("Observations on an *Entamoeba* parasitizing Opalinid Ciliates," *Biol. Bull.*, 1936, **70**, 56–71, 4 pls., 6 text-figs.); (2) T. T. CHEN and R. M. STABLER ("Further Studies on the *Entamoeba* parasitizing Opalinid Ciliates," *ibid.*, 72–7, 8 figs.). In the first paper an account is given of an *Entamoeba* parasitic in Opalinid ciliates of the genus *Zelleriella* from frogs and toads originating from different countries. The number of amoebæ present in each ciliate varies considerably, but they are usually in the same stage. The cysts are uninucleate, but more nuclei are seen in the ones outside the ciliates. Some of the amoebæ themselves were found to be invaded by *Sphaerita*. In the second paper the authors record further genera of Opalinid ciliates parasitized by amoebæ, viz. *Protoopalina*, *Opalina*, and *Cepedea*. The amoebæ have also been found within opalinid cysts, with which they are probably transmitted from adult anurans to tadpoles. C. A. H.

Effect of Trypanosome Infection upon Blood-picture of Host.—S. F. WOOD ("Cytological Variations in the Blood and Blood-forming Organs of White-footed Mice experimentally infected with *Trypanosoma cruzi*," *Univ. California Publ. Zool.*, 1937, **41**, 389–418, 3 pls.). Experimental infection of mice of the genus *Peromyscus* with *Trypanosoma cruzi* produces the following changes in the blood-picture: an increase in the number of large lymphocytes and a decrease in eosinophil leucocytes. There is an enlargement of the spleen and various lymph-nodes, hyperplasia of the lymphoblasts and lymphocytes, and other changes in the hæmopoietic organs. C. A. H.

New Polychætan Gregarine.—P. N. GANAPATI and R. GOPALA AIYAR ("Life-history of a Dicytid Gregarine, *Lecudina brasili* n.sp., parasitic in the Gut of *Lumbriconereis* sp.," *Arch. Protistenk.*, 1937, **89**, 113–32, 10 figs.). Description of a new gregarine, *Lecudina brasili* n.sp., and its development in the gut of a Polychæte worm, *Lumbriconereis* sp., from India. The early stages grow intracellularly in the epithelium, after which the parasite drops into the lumen of the gut and attaches itself to the wall by an epimerite. Mature trophozoites detach themselves and associate in pairs. A detailed description is given of gametogony and conjugation, and subsequent sporulation. The affinities of *Lecudina* with the haplocyte and septate gregarines are discussed. C. A. H.

Pathology of Fowl-Coccidiosis.—R. L. MAYHEW ("Studies on Coccidiosis. X. Histopathology of the Cæcal Type in the Chicken," *Trans. Amer. Micr. Soc.*, 1937, **56**, 431–46, 3 pls.). An account is given of the histological changes produced in the cæcum of chickens infected with *Eimeria tenella*, correlated with the development of this coccidium. C. A. H.

Composition of Myxosporidian Spores.—F. F. BOND ("A Probable Constituent of the Spore Coat of Myxosporidian Spores," *J. Parasit.*, 1937, **23**, 542–3). After treating the spores of various Myxosporidia with Mallory's triple connective tissue stain and also by Feulgen's nuclear reaction, the author concludes that the spore-coat contains thymonucleic acid. The coloration of the coat is correlated with the maturity of the spore, which involves the degeneration of valvular and capsular nuclei. This suggests that the products resulting from degeneration of nuclei are incorporated into the spore coat and the various staining reactions are due to the presence of these products. C. A. H.

Host-Specificity of Myxosporidia.—F. F. BOND ("Host Specificity of the Myxosporidia of *Fundulus heteroclitus*," *J. Parasit.*, 1937, **23**, 540–2). Attempts were made to infect different fishes with the various Myxosporidia parasitic in *Fundulus heteroclitus*. The results with fishes of other genera were all negative, but *F. diaphanus* proved to be susceptible. Since other species of *Fundulus* have also been found infected with the same Myxosporidia, it is concluded that these parasites are confined in their host selection to species of the same genus. C. A. H.

New Myxosporidia.—P. A. MEGLITSCH ("On Some New and Known Myxosporidia of the Fishes of Illinois," *J. Parasitol.*, 1937, **23**, 466–77, 19 figs.). The author reports the result of the examination of 200 fishes of Illinois, belonging to thirty-seven different species, and gives a description of the following five new species: *Myxidium illinoisense* from *Anguilla bostoniensis*, *M. kudo* from *Ictalurus furcatus*, *M. bellum* from *I. punctatus*, *Myxosoma rotundum* from *Carpiodes cyprinus*, and *Henneguya limatula* from *Ictalurus furcatus* and *I. punctatus*. C. A. H.

Infectivity of Malaria Carriers.—N. H. SWELLENGREBEL, A. DE BUCK, and H. KRAAN ("Further Investigations on 'Healthy' Human Carriers of *Plasmodium vivax* in North Holland," *Proc. Roy. Acad. Amsterdam*, 1937, **40**, 368–74). From experiments on G.P.I. patients and observations on the general population it is concluded that healthy carriers with 1 parasite per 100 leucocytes can infect 60 p.c. or more of anophelines which feed on them only once, provided male gametocytes had been found in them previously and no salvarsan had been given. Carriers with 1 parasite per 1000 can likewise infect mosquitos, but to a lesser extent. Anophelines inhabiting a house with a human parasite carrier always acquire an infection earlier or later.
C. A. H.

Mitosis in Opalinid Ciliates.—T.-T. CHEN ("Observations on Mitosis in Opalinids. (Protozoa, Ciliata.) I. The Behaviour and Individuality of Chromosomes and their Significance. II. The Association of Chromosomes and Nucleoli," *Proc. Nation. Acad. Sci.*, 1936, **22**, 594–602, 10 figs.; 602–607. 1 pl.). In the first paper it is shown that in *Zelleriella intermedia*, a binucleate opalinid ciliate, the behaviour of the chromosomes in the course of mitotic division is similar to that in the higher animals and plants and that these chromosomes can be recognized individually by their constant differences in size, by the location of the point of fibre attachment, and by structural peculiarities, e.g. by the presence of nucleoli on certain portions of some chromosomes.

The second paper deals with the two nucleoli of this ciliate. These organelles are associated with specific portions of certain chromosomes, as in some Metazoa. The difference lies in the fact that in *Zelleriella* the nucleolar material does not disappear during mitosis.
C. A. H.

New Parasitic Holotrichous Ciliate.—C. A. KOFOID and M. BUSH ("The Life-cycle of *Parachanna mya*, gen.n., sp.nov., a Ciliate parasitic in *Mya arenaria* Linn. from San Francisco Bay, California," *Bull. Mus. roy. Hist. nat. Belg.*, 1936, **12** (22), 1–15 [sep. pag.], 29 figs.). Description of a new holotrichous ciliate, *Parachanna mya* gen.n., sp.n., from the pericardial cavity and siphon of the clam, *Mya arenaria*, in San Francisco Bay. The cilia are arranged in two areas—a dorsolateral one of long cilia and a ventral one of shorter cilia. There is a long cytopharynx, and a neuromotor system is present. Conjugation is similar to that in *Paramaecium putrinum*.
C. A. H.

New Tillina.—J. P. TURNER ("Studies on the Ciliate *Tillina canalifera* n.sp.," *Trans. Amer. Micr. Soc.*, 1937, **56**, 447–56, 2 pls.). Description of a new holotrichous ciliate, *Tillina canalifera*, n.sp., from a pond in Minnesota. This species differs from *T. magna* in the presence of seven to nine canals running from the contractile vacuole, a complex cytostome and pharynx, and uniform ciliation. There is a single macronucleus and four to fourteen micronuclei. Encystation is also described.
C. A. H.

Structure and Life-activities of Fabrea.—J. M. ELLIS ("The Morphology, Division, and Conjugation of the Salt-marsh Ciliate *Fabrea salina* Henneguy," *Univ. California Publ. Zool.*, 1937, **41**, 343–88, 5 pls., 4 test-figs.). A detailed study of the heterotrichous ciliate *Fabrea salina* found in salt-marsh water in California. A description is given of its general morphology, cytology, and of its method of division and conjugation. It has been cultivated in a medium of sea-water and wheat.
C. A. H.

Encystment in *Blepharisma*.—Y. IBARA ("The Effect of Seasonal Changes of Temperature and the Amount of Culture Fluid on the Life-history of *Blepharisma undulans*, with Special Reference to Encystment," *Annot. Zool. Japon.*, 1937, **16**, 193–204). The author studied the factors affecting encystation in the ciliate *Blepharisma undulans* in cultures and found that the variation in the quality and amount of food was not so important as the temperature at which they are grown, lower temperatures favouring encystment. Evidence is also produced to show that this ciliate encysts in nature.

C. A. H.

Viruses.

Elementary Bodies in Foot-and-mouth Disease and Vesicular Stomatitis.—J. E. BARNARD ("Foot-and-mouth Disease and Vesicular Stomatitis: a Comparative Microscopical Study," *Proc. Roy. Soc., B*, 1937, **124**, 107–112, 2 pl.). Photomicrographs taken with ultra-violet light of wave-lengths 275 m μ and 257 m μ of material obtained from vesicles of foot-and-mouth disease and vesicular stomatitis show the presence of bodies. In the case of vesicular stomatitis the bodies agree in size with the results of filtration experiments, which give the lower limit of size from 80 to 100 m μ . The lower limit suggested by the photographs of foot-and-mouth disease is about 40 m μ , while the results of filtration give 12 m μ . The foot-and-mouth bodies show rod-shaped and spherical forms, with transitional forms from the smallest to the largest. The larger forms are irregular in shape and actively dividing forms are not seen.

G. M. F.

Lymphocystis in the Hogfish.—R. WEISSENBERG, R. F. NIGRELLI and G. M. SMITH ("Lymphocystis in the Hogfish, *Lachnolaimus maximus*, *Zoologica*, 1937, **22**, 303–5, text-fig.). The large connective lymphocystis cells are greatly enlarged, 120–530 μ , with only one nucleus: they are surrounded by a thick hyaline cell membrane and inclusion bodies are present in the cytoplasm. These inclusion bodies consist of a delicate network staining like the basophilic chromatin of the nucleus. As many as thirteen inclusions were found in the same cell, while in the ruffe (*Acerina cernua*) only one network of inclusion bodies surrounds the nucleus.

G. M. F.

Vaccinia Virus in the Developing Egg.—F. F. TANG and H. WEI ("Morphological Studies on Vaccinia Virus cultivated in the Developing Egg," *J. Path. & Bact.*, 1937, **45**, 317–23, 2 pls.). A suspension of vaccinia pulp was passed through a Berkefeld V filter, and hen eggs that had been incubated for 10–12 days were inoculated with the filtrate. The inoculated eggs were re-incubated and were examined at intervals. As development proceeded in the chorioallantoic membrane, two distinct forms of the virus were observed, namely, large and small forms of inclusion bodies. The large form appears at an early stage of development, it probably corresponds to the classical Guarnieri body, and may be regarded as a sort of colony in which the small forms are embedded. The small forms appear to correspond to the Paschen bodies. It is suggested that the virus may possess two independent methods of multiplication. One is by simple division, which involves only the small form of virus. In the second, as the virus particles start to grow, a reaction is produced in the host cell, or its nucleus, resulting in the virus particles becoming glued together into "islands," each of which is provided with a matrix; these islands may be termed the Guarnieri bodies. The presence of these formations is restricted to the early phases of the process, and they probably soon disintegrate and form the elementary or Paschen bodies.

R. T. H.

BOTANY.

(Under the direction of A. B. RENDLE, M.A., D.Sc., F.R.S.)

Anatomy and Morphology.

The Orientation of Cellulose in Wood Cell Walls.—I. W. BAILEY and M. R. VESTAL ("The Orientation of Cellulose in the Secondary Wall of Tracheary Cells," *J. Arn. Arb.*, 1937, **18**, 185-95, 3 figs., 3 pls.). The paper describes a method whereby crystalline aggregates of iodine may be induced to form within the elongated interstices of the cellulose matrix of the secondary wall. These elongated crystals are oriented parallel to the long axis of the fibrils of cellulose and therefore of the micelles and chain molecules. Although the orientation of the cellulose may deviate at times in the successively formed growth rings or lamellae of the central layer of the secondary wall, there is no regular alternation of right-handed and left-handed helixes as hypothesized by various investigators. B. J. R.

The Secondary Wall of Wood Cells.—I. W. BAILEY and T. KERR ("The Structural Variability of the Secondary Wall as revealed by Lignin Residues," *J. Arn. Arb.*, 1937, **18**, 261-72, 4 pls.). In the wood of both gymnosperms and angiosperms, all walls or layers which persist as coherent structural residues on treatment with strong mineral acids usually give an intense coloration with phloroglucin-HCl, whereas those which disintegrate do not, although they may give a strong positive coloration with either the Mäule test or the chlorine-sodium sulphite reaction. Where the walls exhibit an intense coloration with the Mäule test but tend to disintegrate into a finely granular residue on treatment with 72 per cent. sulphuric acid, it is possible to obtain coherent structural residues by first soaking sections in a solution of vanillin or some equivalent reagent. Prevaillingly concentric, dominantly radial, and various intermediate radio-concentric structures occur in different parts of the stems of conifers and of many dicotyledons. In the case of coniferous tracheids, radial structural patterns are formed in parts of the stem and branches which are developing under the influence of geotropic stimuli. The so-called gelatinous fibres of dicotyledonous woods have a conspicuously radial or radio-concentric structure. There is some evidence to indicate that these fibres occur in parts of stems and branches that are developing under the influence of tropistic stimuli. Much additional work remains to be done on dicotyledons in order to determine whether all normal fibre-tracheids and libriform fibres have a prevaillingly concentric structure, and whether all radial and radio-concentric structures of the secondary wall are due to tropistic stimuli. B. J. R.

Comparison of Temperate and Tropical Timbers.—S. H. CLARKE ("A Comparison of Certain Properties of Temperate and Tropical Timbers," *Trop. Woods*, 1937, **52**, 1-11, 2 figs.). Tropical timbers are generally weaker in impact bending but stronger in compression parallel to the grain than temperate-zone timbers of the same specific gravity. The reactions of standard micro-stains and reagents indicate that on the whole the secondary walls of the fibres of tropical

timbers are more heavily lignified (in the botanical sense) than are those of temperate-zone timbers. The negative partial correlation of strength in compression parallel to the grain and in impact bending is compatible with the suggestion that increased lignification may result in increased strength under compression but in decreased toughness. B. J. R.

Gelatinous Wood Fibres.—B. J. RENDLE ("Gelatinous Wood Fibres," *Trop. Woods*, 1937, 52, 11–19). Gelatinous wood fibres are characterized by a highly refractive, gelatinous-looking inner wall, which appears to be unlignified. They occur sporadically in many hardwood genera belonging to widely separated families. They tend to be concentrated on one side of the stem at any one period of growth and their general occurrence is shown to be associated with the formation of tension wood. Other theories regarding gelatinous fibres are briefly considered, notably the suggestion that the gelatinous layer functions as a reserve material. The effect of gelatinous fibres on the properties of wood—its general appearance, strength, machining, and seasoning properties—is described. B. J. R.

Tension Wood in Beech.—S. H. CLARKE ("The Distribution, Structure, and Properties of Tension Wood in Beech, *Fagus sylvatica* L.," *Forestry*, 1937, 11, 85–91, 2 pls.). In beech-trees growing on sloping ground tension wood occurs on the upper sides of non-vertical parts of the trunks. Microscopically, the chief peculiarity of this tissue is the gelatinous appearance of the secondary walls of the wood fibres, which react with so-called cellulose stains and reagents. Compared with normal wood of equal density, tension wood was found to be exceptionally weak under compression parallel to the grain; in tensile strength and toughness, however, it was on the average slightly stronger than normal wood of the same density. In drying from green to oven-dry, tension wood and normal specimens shrank more or less equally in the radial direction; in the tangential direction the tension wood shrank rather more than normal specimens of equal density; in the longitudinal direction the shrinkage of the tension wood was abnormally high. B. J. R.

Wood Anatomy of the Sterculiaceæ.—M. M. CHATTAWAY ("The Wood Anatomy of the Family Sterculiaceæ," *Phil. Trans. Roy. Soc.*, B, 1937, 228, 313–66, 24 figs., 3 pls.). The author concludes that the Sterculiaceæ must be considered a rather advanced family; the genera all have storeyed structure, comparatively short vessel members, simple horizontal perforation plates to the vessels, and alternate pitting. Vessel diameter is variable and appears to have little systematic significance. The size and frequency of the intervacular pitting is constant throughout each genus, with the exception of *Sterculia*. The fibres are libriform and non-septate throughout the family except for the crystalliferous fibres in *Eribroma* and *Sterculia* species. There is a negative relation between vessel-member length and the relative amount the fibres have extended during differentiation. The most advanced type of parenchyma in the family appears to be broad bands that include both metatracheal and paratracheal parenchyma. This form appears to represent the ultimate stage of two separate lines of development, one represented by the series diffuse-narrow metatracheal lines—broad metatracheal bands, and the other by the series vasicentric-aliform-confluent. The rays show very little difference in type throughout the family, and cannot be used to separate the genera, except in the case of *Heritiera*. Crystals are of frequent occurrence throughout the family, and appear to have little phylogenetic significance; they

are, however, useful diagnostic features. Chambered parenchyma and crystaliferous fibres have been studied in *Eribroma* and *Sterculia* species. The taxonomic position of the genera is discussed and the following changes in classification are suggested: *Sterculia pattens* Wall. to be transferred to *Firmiana*; *Brachychiton* and *Eribroma* again to be sunk in *Sterculia*; and the genus *Sterculia* to be subdivided into two subgenera. B. J. R.

Wood Anatomy of Certain Rotenone-Yielding Plants.—A. J. PANSHIN ("Wood Anatomy of Certain South American Rotenone-Yielding Plants," *Amer. J. Bot.*, 1937, **24**, 587–91, 10 figs.) The wood anatomy of stems and roots of *Derris amazonica* Killip and nine species of *Lonchocarpus* yielding rotenone are described and figured with a view to facilitating their identification in the absence of flowers and fruits. The species concerned show a striking similarity in wood structure; it is doubtful whether the recorded differences in the size and number of the wood elements are sufficiently constant to be of diagnostic value. The differences in the colour of the root wood in some cases appear to be constant enough to aid in the field identification of these plants. B. J. R.

Phyllotaxy in *Menyanthes trifoliata* L.—A. PONZO ("Sulla Fillotassi: I Nomofilli di *Menyanthes trifoliata* L.," *Nuov. Giorn. Bot. Ital.*, 1937, **44**, 201–22, 14 figs.). The author considers that arithmetical series and geometrical calculations in phyllotaxy have only a relative value owing to the influence of extrinsic factors. The sparse-ternate ("sparsa-ternata") and partial or total symphyllous arrangements are derived from the opposite-decussate, which is fundamental in both the Dicotyledons and the Mono-cotyledons. This point of view is illustrated by the phyllotaxy of *Menyanthes trifoliata* L. A. W. E.

The Initial and Sheath of the Leaves of Monocotyledons.—A. PONZO ("Ancora sulla punta iniziale e guaina delle foglie nelle Monocotiledoni," *Archiv. Bot.*, 1937, **13**, 36–49, 3 pls.). To his former work on the same subject the author adds observations from various species of *Allium*, *Agapanthus umbellatus* L' Hér., *Muscari commutatum* Guss., *Smilax aspera* L., *Narcissus Tazzetta* L., *Cooperia Drummondii* Herb., *Alstromeria* spp., *Ophiopogon Jaburan* Lodd., *Commelina nudiflora* L., and *Subal Adansonii* Guerns. These confirm his theory that flat, bifacial leaves of Monocotyledons are derived from a primordial, cylindrical, monofacial form which is abbreviated into the initial point and the sheath. This point, with which the leaf is initiated, is of different structure from the petiole, which constitutes a later differentiation from the lamina. A. W. E.

The Epidermis, Systematic and Genetic.—L. LAVIER-GEORGE ("Epidermes, systématique et génétique," *Bull. Soc. Bot. Fr.*, 1937, **84**, 270–9, 8 figs.). A study of several examples from species of *Verbascum*, *Rhododendron*, and *Sedum* shows that epidermal characters are as specific as internal structure or floral morphology. This should be of great service to systematy and genetics and facilitate a *rapprochement* with palaeobotany. A. W. E.

The Embryo of *Amarantus*: Embryological Relations between the Solanaceæ and the Centrospermales.—R. SOUÈGES ("L'embryon chez les *Amarantus*. Relations embryologiques entre les Solanacées et les Centrospermales," *Bull. Soc. Bot. Fr.*, 1937, **84**, 242–55, 48 figs.). The development of the embryo in *Amarantus* shows the closest analogy with that of *Chenopodium Bonus-Henricus* and the Solanaceæ. These resemblances are made clear by a study of the mode of construction of the 8-celled forms, the polymorphism which they show, and the destinies of the constituent blastomeres. A. W. E.

Development of the Embryo in *Radiola linoides* Roth.—R. SOUÈGES ("Développement de l'embryon chez le *Radiola linoides* Roth.," *Bull. Soc. Bot. Fr.*, 1937, **84**, 297–306, 24 figs.). In *Radiola linoides* Roth. embryonic forms do not show the same variations which have been observed in *Linum catharticum* L. All are regularly constructed and can be easily derived, after the third generation, from a 6-storeyed, 8-celled pro-embryo composed of two upper diads superposed on four unicellular layers. The embryo of *Radiola linoides* may be considered typical of the Linaceæ. The developmental laws seem similar to those already established by Chiarugi for the Cistaceæ. A. W. E.

Development of the Ovule in *Symphytum orientale* L.—A. PITOT ("Le développement de l'ovule chez le *Symphytum orientale* L.," *Bull. Soc. Bot. Fr.*, 1937, **84**, 149–53, 2 figs.). The embryo-sac of *Symphytum orientale* L. shows a remarkable evolution. Its contents emigrate, in part, into an ovulary pocket prepared by hypertrophy and destruction of cells. Here we find again the cæcum noted by Vesque. In this way the asymmetry found by that author is explained by the destruction of the external and internal sides of the embryo-sac. The external side is the primitive ceiling of the nucellary cavity pushed back and crushed; the internal side is the hypertrophied floor of the ovulary pocket. A. W. E.

The Strophiole of *Chelidonium majus* L.—P. CRÉTÉ ("Étude sur la strophiole du *Chelidonium majus* L.," *Bull. Soc. Bot. Fr.*, 1937, **84**, 196–9, 6 figs.). Both by its external origin and by its structure the strophiole of *Chelidonium majus* L. should be considered as a true, compound, seminal hair. During its development the nuclei of the cells show great activity and disappear by caryolysis. A. W. E.

Development of the Female Gametophyte in *Asteriscus spinosus* Sch.-Bip.—E. TONGIORGI ("Sviluppo del gametofito femminile in *Asteriscus spinosus* Sch.-Bip.," *Nuov. Giorn. Bot. Ital.*, 1937, **44**, 179–81, 4 figs.). The development of the female gametophyte of *Asteriscus spinosus* Sch.-Bip. is described and the points emphasized in which this species differs from the *Inuleæ*, in which the gametophyte develops according to the normal scheme. A. W. E.

The Female Gametophyte of *Serapias Lingua* L.—L. PARDI ("Il Gametofito Femmineo di *Serapias Lingua* L.," *Nuov. Giorn. Bot. Ital.*, 1937, **44**, 324–9, 12 figs.). The author shows that the development of the female gametophyte of *Serapias Lingua* L. is monomegasporial and generally 6-nucleate by suppression of the ultimate division of the chalazal nuclei of the tetranucleate gametophyte. The unequal cytoplasmic division of the megaspore-cell during both the meiotic divisions is emphasized, and also the reduction of the antipodal apparatus consequent on the degeneration of the chalazal nuclei which no longer function as inferior polar nuclei. A. W. E.

The Germination of *Ephedra altissima* Desf.—ANNETTA SCATIZZI ("Ricerche sulla Germinazione di *Ephedra altissima* Desf.," *Nuov. Giorn. Bot. Ital.*, 1937, **44**, 345–75, 2 pls., 13 figs.). The anatomy of the germination of *Ephedra altissima* Desf. was studied and especially the relations that the seedling maintains with the tissues of the seed during the first stages of its development. A special organ of union between the seedling and the seed called the "*germinal velum*" (*velo germinale*) is described. The ontogenesis, the development, and the transformation of this organ during germination are studied. A. W. E.

The Conducting-system of the Seedling of *Ephedra altissima* Desf.—

ANNETTA SCATIZZI ("Differenziazione del Sistema Conduttore in Plantule di *Ephedra altissima* Desf.," *Nuov. Giorn. Bot. Ital.*, 1937, **44**, 376–80, 3 figs.). The central cylinder of the radicle of *Ephedra altissima* Desf. is traversed by two alternate fibro-vascular bundles. The xylem-bundle consists of an external conducting part and an internal part which functions as a reserve. The growth and evolution of the xylem-bundle to the level of the hypocotyl and its doubling into two cotyledonary bundles come through the sudden transformation of only the conducting zone of the bundle.

A. W. E.

Abnormal Stomatal Apparatus in *Ceratopteris thalictroides*.—F.

PELLISSIER ("Sur un cas de structure anormale de l'appareil stomatique chez le *Ceratopteris thalictroides*," *Bull. Soc. Bot. Fr.*, 1937, **84**, 199–203, 1 fig.). In *Ceratopteris thalictroides* the initial cell, which normally becomes partitioned to form the mother-cell of the stoma and the annex-cell, here forms, by partitioning of the annex-cell, two neighbouring stomatal apparatuses, the one normal and the other U-shaped, clamping the normal one as would the annex-cell.

A. W. E.

Reproductive Cytology of *Isomeris*.—F. H. BILLINGS

("Some New Features in the Reproductive Cytology of Angiosperms, illustrated by *Isomeris arborea*," *New Phytol.*, 1937, **36**, 301–26, 51 figs.). Compared with other investigated species of Capparidaceæ, *Isomeris arborea* differs markedly in its megagametophyte. There is neither fertilization nor meiosis, univalents appearing only at diakinesis. Chromosome counts at all stages were 17. As the range of n -counts in other species of Capparidaceæ is approximately 17, it is possible that this species is a haplodiplont, and is probably the first recorded wild species exhibiting monoploidy. The single archesporial cell is hypodermal; its first divisions result in about four parietal cells. Megaspore production does not usually follow, but any products degenerate. The nucellus and parietal cells become absorbed. The pollen tube may enter the micropyle, but does not discharge its contents. The endosperm is of two types: a nodular type of coarsely granular cytoplasm with free nuclei, and a cellular type consisting of a tissue of vacuolated cells. The embryo arises directly from an endosperm nodule.

W. R. P.

Life History of *Holoptelea*.—S. P. CAPOOR

("The Life History of *Holoptelea integrifolia* Planch. (Ulmaceæ)," *Beih. Bot. Centralbe.*, 1937, **57**, 233–49, 64 figs.). The inflorescence of *Holoptelea integrifolia* is a cluster of dichasial cymes, consisting of a large number of staminate flowers and a few bisexual ones. The development of the anther is quite normal. The tapetum is of the glandular type and its cells are bi-nucleate. The pollen-grains are bi-celled at the time of shedding. The ovule has a massive nucellus and two integuments. A peculiar outgrowth, comparable to an obturator, is formed from the funiculus, and an hypostase appears in the chalaza. The primary archesporial cell divides to form a wall cell and a megaspore mother-cell. A normal tetrad of megaspores is formed, and the chalazal develops into an eight-nucleate embryo-sac. The antipodal cells divide to form a group of four to ten cells. The endosperm is free-nuclear, the seed exalbuminous. The chromosome number is $2n=28$.

W. R. P.

Morphology of *Ranzania*.—M. KUMAZAWA

("Ranzania japonica (Berberidaceæ). Its Morphology, Biology, and Systematic Affinities," *Jap. J. Bot.*, 1937, **9**, 55–70, 6 figs.). *Ranzania japonica* is geophilous, sending up an aerial stem bearing a pair of apparently opposite ternate leaves, on the petioles of which are lateral stipules. A fascicle of several peduncles arises from between these

leaves. The rhizome is a sympodium. In the seedling, spiral phyllotaxy is gradually evolved from an original distichous arrangement. The vascular bundles in the stem, about twenty to forty in number, are arranged in two irregular series. Each peduncle contains about ten bundles in a single series and these fuse with leaf-traces at the node. The morphology of the floral parts is also described. The germination and development of the seedling are described; the plant flowers in its fourth year. The morphological and biological characters tend to show the affinity of *Ranzumia* with the Tribe Epimerideæ and the floral characters with the Berberideæ. The unique dehiscence of the anthers, however, shows the genus to be rather more isolated than has previously been admitted.

W. R. P.

Life History of *Santalum album*.—G. S. IYENGAR ("Life History of *Santalum album* L.," *J. Ind. Bot. Soc.*, 1937, **16**, 175–95, 7 figs.). The formation of the megaspore mother-cells in *Santalum album* is found to be normal. In megasporogenesis the hypodermal archesporial cell, after a single division, forms a parietal and a sporogenous cell, around which a nutritive tissue is soon formed. A typical linear tetrad is formed of which the chalazal megaspore develops. A few tracheids appear at the chalazal end. The binucleate and tetranucleate stages are normal. The eight-nucleate sac is in the form of the letter L. The antipodals disorganize as soon as they are formed. The chalazal end of the sac grows into the placenta. There is no double fertilization. The first division of the fusion nucleus results in a two-chambered sac, of which the larger and antipodal division produces the haustorium, and the shorter micropylar one the endosperm.

W. R. P.

Cytology of *Eleusine coracana*.—N. KRISHNASHWAMY and G. N. AYYANGAR ("Cytological Studies in *Eleusine coracana* Gaertn. Ragi—the Finger Millet," *Beih. Bot. Centralbl.*, 1937, **57**, 297–318, 84 figs.). The chromosome number of *Eleusine coracana* is $2n=36$; the chromosomes are small and more or less uniform. The morphology of the spikelet is described. Microsporogenesis is typical. Megasporogenesis is also typical; the innermost of the linear tetrad functions as the megaspore. There are three very large passive antipodal cells. The embryogeny is typical.

W. R. P.

CRYPTOGAMIA

Pteridophyta

Psaronius.—NORMAN J. GILLETTE ("Morphology of Some American Species of *Psaronius*," *Bot. Gaz.*, 1937, **99**, 80–102, 20 figs.). Little has been published hitherto upon American specimens of the Palæozoic tree fern *Psaronius*. As a result of a morphological study four specimens are referred to the following three species: *P. septangulatus* Gillette, *P. peoriensis* Gillette, and *P. Giffordii* Potonié. The latter species has six rows of leaves arranged in two whorls, while *P. septangulatus* and *P. peoriensis* have seven rows of leaves arranged spirally. The vascular anatomy of *P. septangulatus* was studied in detail from a series of transverse sections of the stem. The leaf traces diverge outwards from the centre of the stem axis in the manner described for *P. infarctus*, a species with whorled leaves. Thin sections of all three species were examined and are described.

A. G.

Isoëtes.—EDWARD C. JEFFREY ("The Cytology of a Heterosporous *Isoëtes*," *Bot. Mag., Tokyo*, 1937, **51**, 203–9, 8 figs.). An account of a remarkable *Isoëtes* which is found in the lakes of Cape Breton Island, Nova Scotia. It is of large size

with numerous reddish-brown, much recurved leaves. The megaspores vary much in size and often are united in pairs, the process of separation having remained uncompleted. The development of the microspores is described: they are abortive, and even when fully mature they remain grouped in their original tetrads. The plant might be a variety of *I. Tuckermanni*, but in all probability it is the result of interspecific hybridization. A. G.

Selaginella.—EDGAR T. WHERRY ("Observations on *Selaginella tortipila*," *Journ. S. Appalachian Bot. Club*, 1, 65-9). A special study of all available material of *Selaginella tortipila* A. Braun, and *S. Sherwoodii* Underwood shows that they cannot be maintained as specifically distinct. The second must be regarded as a mere ecological form of the first, merging into it in habit, foliage, strobili, and megaspore structure. The distribution in Carolina, Georgia and Tennessee is given. A. G.

Selaginellæ of Sumatra.—A. H. G. ALSTON ("The Selaginellæ of the Malay Islands. II. Sumatra," *Bull. Jard. Bot. Buitenzorg.*, 1937, sér. III, 14², 175-86). A revision of the Sumatran species of *Selaginella*, with a key to the twenty-nine species. Synonyms, localities, collectors, distribution are all cited. A. G.

Monachosorum and Ptilopteris.—MOTOZI TAGAWA ("*Monachosorum* and *Ptilopteris*," *Jap. Journ. Bot.*, 1937, 9, 107-120, 12 figs.). The genus *Monachosorum* is of uncertain affinity; it is here regarded as containing four species and one variety, all of which are figured and furnished with descriptions, synonymy, citations, and distribution; and there is a key to the species. While some of these bear bulbils in the axils of the primary pinnae, *M. flagellare* is often viviparous at the apex of the rachis. The genus *Ptilopteris* founded by Hance in 1884 is here emended so as to include only *Pt. Maximowiczii*, an exindusiate species. *Pt. Hancockii* is a *Polystichum* with fugacious indusia. Description, figures, synonymy, distribution, etc., of *Pt. Maximowiczii* are given. A. G.

Lindsaya in Japan.—MOTOZI TAGAWA ("The Genus *Lindsaya* in Japan," *Acta Phytotax. et Geobot.*, 1937, 6, 24-41, 4 figs.). A revision of the species of *Lindsaya* which occur in Japan. Ten species and two varieties are recognized. Descriptions of these are given, with their synonymy and distribution. The numerous figures show the outlines of the pinnae, the venation, and the involucre. Critical notes are appended and a key to the Japanese species facilitates the determination of specimens. Two new species are described. A. G.

Ferns of Cavanilles.—CARL CHRISTENSEN ("Revision of the Genera and Species of Ferns described by A. J. Cavanilles," *Dansk Botanisk Arkiv*, 1937, 9, Nr. 3, 1-32, 1 fig., 4 pls.). Nearly all the types of the ferns described by Cavanilles (between 1799 and his death in 1804) had been collected by the Spaniard Luis Née during the *Malaspina* Expedition (1789-1794), which sailed from Spain to Buenos Ayres, cruised along the Pacific Coast of America, crossed to Manila, visited Australia, etc., and returned round Cape Horn. The localities cited by Cavanilles are often wrong; and his type specimens had remained unexamined until Dr. Christensen studied them in detail. He found that three out of six genera set up by Cavanilles are maintained, and out of 101 of Cavanilles's species thirty-two are valid, twenty-two have already been correctly interpreted, while forty-seven had been misunderstood or were unknown. All but six of these are now made known and are referred to their proper systematic position. The Austrian botanist Thaddeus Haenke was also attached to the *Malaspina* Expedition, and his ferns were named by C. B. Presl and are well known to pteridologists. A. G.

Beccari's Ferns.—CARL CHRISTENSEN ("Revision of the Bornean and New Guinean Ferns collected by O. Beccari and described by V. Cesati and J. G. Baker," *Dansk Botanisk Arkiv*, 1937, 9, Nr. 3, 33–52, 1 fig., 1 pl.). Beccari's ferns were determined first by Cesati, and were revised by Baker. The types have all been critically studied by Christensen, whose results are given in the present paper, where all misunderstanding of the species is removed. A. G.

Papuan Ferns.—CARL CHRISTENSEN ("New and Noteworthy Papuan Ferns," *Brittonia*, 1937, 2, 265–317, 2 figs.). A list of a hundred ferns collected by L. J. Brass on the mountains of Central Papua during the Archbold Expedition in 1933–34. The forty new species described include some remarkable ferns—*Marattia tafaënsis*, *Cyathea gleichenioides*, and *Papuapteris*, a new genus of Dryopterideæ. Six new varieties are described, and critical notes are added to most of the species. It is estimated that a harvest of 2000 ferns should be forthcoming from New Guinea when the unknown parts have been explored. A. G.

Japanese Ferns.—MOTOZI TAGAWA ("Spicilegium Pteridographiæ Asiæ Orientalis, 13," *Acta Phytotaxonomica et Geobotanica*, 1937, 6, 89–100). A series of sixteen species and two varieties of ferns from Japanese territories, with their synonymy, literature, and distribution. Five new species are described; and of the others three are new to the flora of Formosa, two to that of Korea, and one to Saghalien. A. G.

New Ferns.—CARL CHRISTENSEN ("Descriptions of 36 New Species of Ferns," *Dansk Botanisk Arkiv*, 1937, 9, Nr. 3, 53–73, 2 pls.). A series of descriptions of new species of ferns, arranged in alphabetical order. More than half of them were collected in Borneo or the Malayan islands, and the rest from Africa, China, S. America, etc.; some were recently gathered, others have been in various museums for several years. Some are figured; and to several of them critical notes are appended. A. G.

Bryophyta.

Riella.—GRACE WIGGLESWORTH ("South African Species of *Riella*, including an Account of the Developmental Stages of Three of the Species," *Journ. Linn. Soc. Bot.*, 1937, 51, 309–32, 58 figs.). Four new species of *Riella* from South Africa are described, and a new diagnosis of *R. capensis* Cavers is provided. The distinctive characters of the spores are figured. The early stages of growth and the attainment of the adult form are described as far as was possible. The morphology and affinity of the South African species are discussed; and a key to all the described species of *Riella* has been drawn up. A. G.

Parasite Hepatics.—AD. DAVY DE VIRVILLE ("Recherches sur le parasitisme chez les Muscinées," *Rev. Gén. de Bot.*, 1937, 49, 5–35, 15 figs., 3 pls.). The existence of parasitism among hepatics is revealed. The rhizoids of *Lophocolea bidentata* can become transformed into sucker-clamps applied to *Anomodon viticulosus* and other mosses and draw nutriment from the moss. The parasitism is proved by the development of suckers on the rhizoids; by the pallid colour of the leaves of the *Lophocolea*, which indicate that the parasite derives part of its glucides from the host and not from photosynthesis; by the experiment of immersing the lower part of the host-moss in staining solutions, which, passing up inside the moss stem, are absorbed by the parasitic hepatic; and by the fact that such a *Lophocolea*, deprived of all contact with the soil, but attached to the moss, can continue to form

leafy branches. It is a case of facultative parasitism. Other instances are: *Lophozia* parasitic on *Racomitrium*; *Microlijeunea ulicina* and *Frullania fragilifolia* on *Hypnum cupressiforme* or *Neckera*; and especially *Odontoschisma sphagni*, *Coleochila anomala*, *Lophozia incisa*, and various species of *Cephalozia* and *Cephalozella* on tufts of *Sphagnum*. A. G.

Appalachian Bryophytes.—AARON J. SHARP ("Interesting Bryophytes, mainly of the Southern Appalachians," *Journ. S. Appalachian Bot. Club*, 1936, 1, 49-59, 1 pl.). An annotated list of eleven hepatics and fifty-eight mosses mostly from Tennessee and North Carolina. They are of interest either as being rare or little known or as being far removed from their recorded ranges or habitats. Figures of twelve species are included in the plate. A. G.

Japanese Mosses.—REIZO TOYAMA ("Spicilegium Muscologiæ Asiæ Orientalis 3," *Acta Phytotaxonomica et Geobotanica*, 1937, 6, 101-107, 5 figs.). Descriptions and figures of five new species of mosses, and critical notes on some others. A. G.

Thallophyta.

Algæ.

Aëroplankton.—MARIE ANTOINETTE VAN OVEREEM ("On Green Organisms occurring in the Lower Troposphere," *Rec. Trav. Bot. Néerlandais*, 1937, 34, 388-442, 9 figs., 2 pls.). A review of the literature of air-borne organisms; description of some apparatus designed to filter out organisms from the upper air during the flight of aeroplanes at altitudes between 300 and 6000 feet; method of treatment of the samples in the laboratory. Twenty-four samples, each filtered from about 1 cu. meter of air were examined and revealed the presence of nine species of algæ, one moss (*Funaria*), and one fern. Of the algæ, *Chlorococcus* occurred most frequently in the samples. The quantity of organisms decreased at the higher altitudes; also it was greater during dry weather. Similar organisms were found in air-samples taken on the top of high buildings. A. G.

Erlensee Diatoms.—E. BRADLER ("Die Diatomeen-Vegetation des Erlensees," *Mitteil. Thüring. Bot. Vereins*, 1936, 43, 46-56, 14 figs.). A list of the diatoms contained in three samples taken from the Erlensee in Werratal, Thuringia. The Erlensee is one of several funnel-shaped depressions of the local land-surface, due to subsidence into cavities in the layer of rock salt situated 500 feet below. The water of this lake is saline; and in its flora are found a number of halophyte phanerogams. In the list of diatoms are tabulated 193 species and fifty varieties, among which are twenty-three marine and forty-four brackish-water forms. A. G.

Japanese Diatoms.—B. W. SKVORTZOW ("Diatoms from Ikeda Lake, Satsuma Province, Kiusiu Island, Nippon," *Philippine Journ. Sci.*, 1937, 62, 191-218, 4 pls.). A list of 128 species of diatoms and numerous varieties and forms from Ikeda Lake near Kagoshima in Japan, no previous records from which have been published. The novelties are five species, twelve varieties, and six forms. A. G.

Baikal Diatoms.—B. W. SKVORTZOW ("Bottom Diatoms from Olhon Gate of Baikal Lake, Siberia," *Philippine Journ. Sci.*, 1937, 62, 293-377, 18 pls.). A list of over 200 species of diatoms and numerous varieties and forms, based on a bottom

sample collected by Prof. K. I. Meyer at 33 metres depth near the Olhon Gate of Baikal Lake in July, 1916. Many novelties are described—fifty-six species, sixty-five varieties, and seventeen forms; and figures of these and many other interesting species are given in the plates. In the introduction are notes on the physical geography and biology of the lake. The diatom flora is of an Arctic type and is divisible into five groups: (a) Siberian and subalpine forms (about half the flora); (b) Tertiary freshwater relicts and tropical species; (c) marine elements (very few); (d) brackish water species; (e) elements of uncertain origin (Baikal endemics). Separate lists of these are given. A. G.

Canal Plankton.—CHARLENE COFFING ("A Quantitative Study of the Phytoplankton of the White River Canal, Indianapolis, Indiana," *Buller Univ. Bot. Studies*, 1937, 4, 13-31, 8 figs). The results of a study of the phytoplankton of the White River Canal throughout one year by an examination of samples taken week by week. Though the total plankton showed considerable weekly variation, there was a summer maximum (June to October) and a winter minimum (November to February). The summer maximum included a large peak in June and a smaller peak in October caused by a sudden increase of *Tribonema*. The maximum of Chlorophyceæ corresponded with the summer curve of temperature, *Scenedesmus* being the most abundant genus. The diatoms began their increase in March, but, though following the summer temperature curve, they fluctuated more than the Chlorophyceæ from week to week; *Synedra* and *Nitzschia* abounded in early summer, *Cyclotella* in late summer. Myxophyceæ occurred but seldom. A list is given of five ecological groups and of the genera comprised in them. A. G.

Cyanophyceæ.—KAROL STARMACH ("Algologische Notizen I-II," *Act. Soc. Bot. Poloniae*, 1936, 13, 23-37, 2 figs.). Notes on two species of Cyanophyceæ. *Pleurocapsa aurantiaca*, described by Geitler in *Rabenhorst Kryptogamenflora*, 1932, 14, 354, has recently been found on the Tatra-Gebirge in Poland, and its sporangia are now described and figured for the first time. These are borne apically on the short filaments and are enclosed in a thickened stratified membrane; the endospores, usually thirty-two or more, are produced by successive divisions of the endosporangial cells; normally they escape after the dissolution or splitting of the sporangial wall; but very often this does not occur until after development of the spores has begun, in which case the sporangial wall stretches and expands under the pressure of the germinating endospores. The other species gathered on the Tatra-Gebirge is *Pseudocapsa dubia* Ercegovic. It was found at two places in all stages of growth. The colonies of cells are rounded at first, and become polygonal by the formation of daughter-cells. Old colonies are flattened and the enclosing membrane become cuticularized on the outside. With the normal colonies occur others which are regarded as resting stages; in these the angular cells become rounded off and enclosed in a distinct membrane, the colonial envelope becoming at the same time wrinkled and hardened. The resting cells, when set free, doubtless initiate new colonies. A. G.

Euglena.—ROSE BRACHER ("The Light Relations of *Euglena limosa* Gard. Part I. The Influence of Intensity and Quality of Light on Phototaxy," *Journ. Linn. Soc. Bot.*, 1937, 51, 23-42, 4 figs.). *Euglena limosa* carpets the tidal mud of the Bristol Avon in summer; it is amoeboid and without flagella. In light of low intensity it burrows beneath the surface; in brighter light it comes to the surface again; at the approach of high tide it burrows. The interaction of the factors which control these movements of *Euglena limosa* up and down in the mud is of a

complex nature. The tidal rhythm, the strength of illumination, and the quality of the light were all studied and measured. By means of Wratten filters the most effective region of the spectrum was found. A. G.

British Algæ.—J. W. G. LUND ("Contributions to our Knowledge of British Algæ. VI. Some New British Algal Records. I," *Journ. Bot.*, 1937, **75**, 305-14, 4 figs.). The first of a series of papers recording algæ new to the British flora which have been found in four ponds in Richmond Park, Surrey. The present instalment comprises figures and descriptive accounts of *Holopedium geminatum* Laut., *Cylindrospermum alatosporum* Fritsch, *Trachelomonas varians* Defl., *Chrysamœba radians* Klebs, *Mallomonas akromonas* Ruttner, *Meso-stigma viride* Laut. A list of fifteen other rare algæ found in the marginal sediment of these ponds is included. A. G.

Floridean Spore Development.—E. CHEMIN ("Le Développement des Spores chez les Rhophycées," *Rev. Gén. Bot.*, 1937, **49**, 205-34, 300-27, 353-74, 424-48, 478-536, 95 figs., 4 pls.). An account of the development of the spores of a hundred species of red algæ, preceded by chapters on the historical aspect of the subject, the modes of cultivation, the discharge of the spores and their movements when freshly shed. In summing up his results he indicates five types of development: the bipolar type of *Ceramium*, where a rhizoid emerges at one end of the spore and a shoot at the other; the morula-like type of *Dumontia*, where the spore quickly undergoes a large number of divisions in all directions, occurring in Cryptonemiales, Gigartinales, and Rhodymeniales; in the *Nemalion* type the spore completely empties itself of its contents, which develop into a filament; in the *Gelidium* type the spore empties itself, but an adhesive disc is formed, not a filament; in the *Naccaria* type the spore does not empty itself, but puts out shoots in various directions. The influence of temperature and of various kinds of light are discussed. A. G.

Spermothamnion.—KATHLEEN M. DREW (Mrs. Baker) ("*Spermothamnion Snyderæ* Farlow, a Floridean Alga bearing Polysporangia," *Ann. Bot.*, 1937, N.S. **1**, 463-76, 12 figs., 1 pl.). *Spermothamnion Snyderæ* reproduces sexually in the normal fashion of Ceramiaceæ, but its asexual reproduction is by polyspores. The polysporangia are born on diploid plants; the sporangium mother-cell may contain from two to nine nuclei, all of which undergo a reduction division, the haploid number of chromosomes in the nuclei being 32. The polysporangium appears to be homologous with the tetrasporangium of other Florideæ, and differs only in having a multiple of four spores. The sexual plants are dioecious and haploid. The spermatangial branches are normal for the genus, and the procarys resemble those of *S. Turneri*. The cystocarps develop like those of *S. Turneri*, but have no enveloping filaments. The life-history of *S. Snyderæ* is like that of a typical diplobiontic alga. A. G.

Iridophycus.—WILLIAM ALBERT SETCHELL and NATHANIEL LYON GARDNER ("*Iridophycus*, with special reference to South American Species," *Univ. California Publ. Bot.*, 1937, **19**, 195-244, 7 pls.). A critical revision of the genus *Iridea* or *Iridæa*, with an explanation of the reasons which have necessitated the employment of a new generic name—*Iridophycus*; and a special scrutiny of the South American species. Two sections proposed by J. G. Agardh are retained—*Euridæa* and *Porphyroidæa*, the former including six species and the latter one species. And two new sections are proposed—*Chondriridæa* (with one species) and *Gigartiridæa* (with three species). A few other species which have been referred by former authors to *Iridæa* are discussed and allocated to their proper genera. A. G.

Claudea and Vanvoorstia.—GEORGE F. PAPPENFUSS ("The Structure and Reproduction of *Claudea multifida*, *Vanvoorstia spectabilis*, and *Vanvoorstia coccinea*," *Symb. Bot. Upsal.*, 1937, 2, No. 4, 1-66, 72 figs.). An investigation of the reticulate structure of these three algæ and of the development of their reproductive organs. In *Claudea* the thallus consists of three orders of laminæ, the primary and secondary being long and the tertiary short. The secondary laminæ are initiated on the ventral surface of the primary by the central cells in successive segments. The tertiary laminæ arise similarly from the secondary, and they anastomose at their tips with the dorsal surface of the secondary lamina immediately above. The mode of initiation of the laminæ, the process by which the tertiary become united to the secondary, and the subsequent development of the bars of the net are described in detail. The procarps are formed in acropetal succession on the long laminæ. The tetrasporangia are formed on the short laminæ. Similarly, the structure and mode of development of the thallus of *Vanvoorstia spectabilis* and *V. coccinea* and their reproductive organs are described. A. G.

Regeneration in Algæ.—E. M. DELF ("Regeneration in certain Brown Algæ," *Proc. Linn. Soc. London*, 1937, 149th Session, 112-113, 1 fig.). Instances of regeneration in *Fucus*, *Laminaria*, and *Macrocystis* are cited, and a brief description of a new and rare proliferating *Ecklonia* from New Zealand, in which many of the teeth had proliferated into haptera cylindrical or grooved and slightly branched; these, it is suggested, can give rise to new plants when the main thallus has broken away. A. G.

Marginariella.—E. MARION DELF (Mrs. Percy Smith) ("The Oogonia of *Marginariella Urvilliana* (Rich.) Tandy," *Journ. Bot.*, 1937, 75, 273-84, 5 figs., 1 pl.). The examination of pickled material of *Marginariella Urvilliana* collected in New Zealand in July, 1936, revealed three layers in the oogonial wall; from the exochiton the mesochiton is differentiated off early, and, increasing in thickness, it develops into folds; it consists mainly of pectin. The endochiton is mucilaginous and closely invests the oosphere, developing a dense cap of mucilage above it. This swelling cap bursts the apex of the exochiton. The mesochiton straightens out its folds and becomes a long tube anchored below to the exochiton and stretching out through the ostiole carries the oosphere, still embedded in mucilage, in its free end. Nuclear divisions now take place; of the eight daughter nuclei only one survives. Sometimes young antheridial tufts are found between the oogonia; sometimes very young oogonia are detected in antheridial conceptacles; possibly there is an alternation of sex; but the general impression is that the receptacles borne on a given pinna are either all male or all female. A. G.

Himanthalia.—DOROTHY C. GIBB ("Observations on *Himanthalia lorea* (L.) Lyngb.," *Journ. Linn. Soc. Bot.*, 1937, 51, 11-21, 3 figs, 2 pls.). A study of *Himanthalia lorea* growing on the coast of the Isle of Man showed that the vegetative part of this alga varies in form according to the tide level at which it grows. At the higher tide levels it is much flattened, button-like, short-stalked, and takes 1-2 years to mature; at the lower limits of the zone the shape is conoid with the broad surface upwards, margined by a rim and somewhat depressed in the middle; this form is less tough in texture and matures earlier. Intermediate forms occur. The receptacles are described; and an account is given of the mechanism of release of the sexual products. The development of the young sporeling was traced by cultures until it attained a length of 1 mm. A. G.

Norfolk Algæ.—V. J. CHAPMAN ("A Revision of the Marine Algæ of Norfolk," *Journ. Linn. Soc. Bot.*, 1937, **51**, 205–63, 9 figs., sketch-map, 1 pl.). A list of 295 algæ collected on the coast of Norfolk with their locality, littoral zone, time of occurrence, and with chapters on the nature of the coast, the ecology of the algæ, the factors controlling algal distribution, and the ecological units. A. G.

Nitella.—B. C. KUNDU ("A New *Nitella* from Rajshahi, Bengal," *Journ. Ind. Bot. Soc.*, 1937, **16**, 223–6, 12 figs.). Description of a new species of *Nitella*, which was found in a shallow ditch at Sardah growing with *Ceratophyllum* and *Najas*. It is characterized by dactyls of three different kinds and by the tuberculate membrane of the oospore. A. G.

Fungi.

Phycomycetes.—K. M. CROOKS ("Studies on Australian Phycomycetes," *Proc. Roy. Soc. Victoria*, 1937, **49**, 206–33, 1 pl.). An account of some Blastocladales and Saprolegniales which, with the exception of *Saprolegnia ferax*, have not previously been recorded for Australia. The fungi were collected by the usual method, for this group, of suspending traps with bait in ponds and streams for 4–6 weeks. They were then examined in the laboratory and cultured, if possible, on agar, etc. A systematic and physiological description is given of twenty species so gathered. *Blastocladia aspergilloides* is described for the first time. A variety, *megalosperma*, new to science is made for *Achlya americana*. F. L. S.

Pythium.—W. R. IVIMEY COOK and W. B. COLLINS ("A *Pythium* Wilt of *Primula* caused by *Pythium spinosum* Sawada," *Trans. Brit. Myc. Soc.*, 1937, **21**, 29–34, 7 figs.). A fungus was found on the roots of *Primula sinensis* which was in a diseased condition. It was subsequently realized, however, that the primary cause of the disease was not due to the fungus but to the soil not being sufficiently porous. Transference to better soil led to recovery of the *Primulas*. The fungus was nevertheless examined and proved to be *Pythium spinosum*. Moreover, it was discovered that it originated from the soil and not from the *Primula* seed. F. L. S.

New Saprolegnia.—I. COOKSON ("On *Saprolegnia terrestris* sp. nov., with Some Preliminary Observations on Victorian Soil Saprolegniales," *Proc. Roy. Soc. Victoria*, 1937, **49**, 235–43, 1 pl.). The *Saprolegnia* described for the first time was found in soil in fern gullies of the Dandenong Range near Melbourne. It was cultured on hemp seed in sterilized water. It has excentric oospores, but differs from *S. spiralis*, which also has this feature in not having spirally coiled oogonial stalks. Other soil fungi found and described are *Achlya imperfecta*, *A. apiculata*, *A. racemosa*, *A. caroliniana*, *Saprolegnia megalosperma*, *S. anisospora*, and *Isoachlya unispora*. F. L. S.

Sapromyces.—K. CEJP ("Sapromyces androgynus, Thaxter en Europe et étude de l'espèce *Sapromyces Reinschii* (Schröter) Fritsch," *Bull. Soc. Myc. Fr.*, 1936, **52**, 370–7, 2 pls.). An account of *Sapromyces androgynus* Thaxter found in Western Bohemia and previously only recorded from America. *S. Reinschii*, the only other species of this genus, is also described. F. L. S.

Sclerotinia.—G. ARNAND and J. BARTHELET ("Les Microconidies dans le Genre *Sclerotinia*," *Bull. Soc. Myc. Fr.*, 1936, **52**, 63–80, 8 figs.). A detailed account, with excellent drawings, of the different types of conidia occurring in *Sclerotinia*. F. L. S.

Bunt.—A. M. SCHLEHUBER ("Studies in the Effect of Bunt, *Tilletia Triticici* and *Tilletia levis*, on Wheat," *Phytopath. Zeitschr.*, 1937, **10**, 614–33, 9 figs.). The paper deals with investigations of the effect of bunt on winter-hardiness, rapidity of growth, and floret sterility of the wheat. F. L. S.

Lepiota.—M. R. KÜHNER ("Recherches sur le genre *Lepiota*," *Bull. Soc. Myc. Fr.*, 1936, **52**, 177–239, 9 figs., 1 pl.). Following Lange's publication of his "*Flora Agaricina Danica*," Kühner decided to assemble his own notes on the genus *Lepiota*. The result is a detailed paper with keys to the sections and species of the genus. F. L. S.

Cortinarius.—R. HENRY ("Révision de quelques Cortinaires (Suite)," *Bull. Soc. Myc. Fr.*, 1937, **53**, 49–81). A detailed comparative study of species of *Cortinarius* belonging to the sections *Inoloma*, *Dermocybe*, and *Telamonia*. F. L. S.

Phlegmacium.—M. R. HENRY ("Révision de quelques *Phlegmacia* appartenant aux groupes des Cliduchi et des Elastici," *Bull. Soc. Myc. Fr.*, 1936, **52**, 279–300). Detailed notes on six species of *Cortinarius* (*Phlegmacium*) under the heads: general and historical aspect; macroscopic, microscopic, and chemical characters; habitat and critical notes. A reference is also given to illustrations. F. L. S.

Hypholoma.—M. R. KÜHNER ("Observations sur le genre *Hypholoma*," *Bull. Soc. Myc. Fr.*, 1936, **52**, 9–31, 4 figs.). A general account of the genus *Hypholoma* with a discussion of its affinities and a detailed description and key of some of the smaller species, a few of which have, for a long time, been placed under *Psilocybe*. F. L. S.

Fomes.—K. LOHWAG ("*Fomes Hartigii* (Alesch.) Sacc. et Trav. und *Fomes robustus* Karst.," *Ann. Myc.*, 1937, **35**, 339–50, 2 figs.). Detailed accounts of the structure and action of *Fomes Hartigii* and *F. robustus*, which are often confused with each other. F. L. S.

Actinomycetes.—J. BADIÁN ("O budowie Cytologicznej i cyklu rozwojowym promieniowców (Actinomycetes). (Über die zytologische Struktur und den Entwicklungszyklus der Actinomyceten)," *Act. Soc. Bot. Pol.*, 1936, **13**, 105–27, 1 pl.). Five strains of *Actinomyces* were examined and all showed a similar type of structure and development. The spore-producing aerial hyphae arise as lateral branches of the vegetative filaments. Each sporogenous thread has at first numerous chromosomes. These turn through an angle of 90° and take up a position parallel to the long axis of the hypha. They then fuse in pairs, become thicker, and turn again until they are at right angles to the hypha. In some cases more than two chromosomes fuse, so forming a long chromatin thread which finally breaks up into chromosomes. The spores are formed by each chromosome becoming surrounded by a portion of protoplasm; they are set free by degeneration of the hypha. Each spore germinates by putting out one to three germ-tubes, which become the vegetative hyphae. The chromosome of the spore divides into four daughter-chromosomes, each germ-tube receiving one, the remainder degenerating. This process is regarded as serving as the reduction division. F. L. S.

Trichophyton.—A. M. DAVIDSON and P. H. GREGORY ("The Spiral Hyphae of *Trichophyton*," *Trans. Brit. Myc. Soc.*, 1937, **21**, 98–114, 5 figs.). Examination of the spiral hyphae of a number of strains of *Trichophyton gypseum*, *T. interdigitale*, and one strain of *T. persicolor*, *T. asteroides*, and *T. granulosum* led to the conclusion

that they are organs of attachment of value in the dissemination of the fungus and for infecting animal hosts from saprophytic sources. Mature spirals are empty and dead hyphæ. Counter-clockwise spirals were predominant. F. L. S.

Entomogenous Fungi.—T. PETCH ("Notes on Entomogenous Fungi," *Trans. Brit. Myc. Soc.*, 1937, **21**, 34-67). Notes on thirty-three species of Entomogenous fungi from all parts of the world. F. L. S.

New Fungi.—M. L. ROGER ("Quelques champignons exotiques nouveaux ou peu connus. II," *Bull. Soc. Myc. Fr.*, 1936, **52**, 80-5, 2 figs.). *Meliola disciseta*, n.sp., found on leaves of *Memecylon fasciculare* in French Guinea, *Geopyxis striatospora* n.sp., from the Ivory Coast, *Coniothyriella Theobromæ* n.sp., and *Helminthosporium Lycopersici* n.sp., also from the Ivory Coast, are described and illustrated by means of clear drawings. F. L. S.

Micromycetes.—H. SYDOW ("Neue oder Bemerkenswerte Australische Micromyceten. II," *Ann. Myc.*, 1937, **35**, 350-62). An account of twenty-one species of microfungi found in Australia. Of these the following are described for the first time: *Cytospora Notelaceæ*, *Phyllachora melaspilea*, on leaves of *Scolopia Brownii*; *Asterina decora*, on leaves of *Melicopes australasica*; *A. Cordylinæ*, *Lembosia capnoides*, on leaves of *Tristunia Laurina*; and *Metadiplodia Eucalypti*, type species of the Sphærøpsidaceous genus, *Metadiplodia*, here described for the first time, and *Hendersonia phyllodiorum*, on phyllodes of *Acacia gladiiformis*. All are from New South Wales. F. L. S.

Anomalies.—M. E. MARTIN-SANS ("Anomalies chez quelques champignons," *Bull. Soc. Myc. Fr.*, 1936, **52**, 363-8, 2 figs.). The anomalies described do not present any new teratological feature, but are of interest in occurring in species in which they have not previously been recorded. The anomalies described are reduction of the cap in *Laccaria amethystea* until it is a mere column or point, morcheloid swelling of the cap of *Russula aurata*, fasciation in *Russula ochroleuca*, superposition of two individuals in *Marasmius oreades*, and coalescence of the caps in *Laccaria laccata*, *Boletus chrysenteron*, and *B. armeniacus*. F. L. S.

Brown Oak.—K. ST. G. CARTWRIGHT ("A Reinvestigation into the Cause of the 'Brown Oak,' *Fistulina hepatica* (Huds.) Fr.," *Trans. Brit. Myc. Soc.*, 1937, **21**, 68-84, 6 figs., 7 pls.). The cause of "brown oak," a discoloration of the heartwood, was found to be *Fistulina hepatica*. Cultures obtained from "brown oak," examination of microtome sections, and inoculation experiments led to this conclusion. A number of physiological experiments were performed to determine optimum temperatures for the culture of the fungus and the source of its sugar supply. Mechanical tests of wood affected by *Fistulina hepatica* showed that no appreciable loss in strength occurred in early stages of attack. F. L. S.

Polysporous Asci.—P. MARTEUS ("Les Ascomycètes à Asques Polyspores," *Bull. Soc. Myc. Fr.*, 1936, **52**, 379-408). The paper includes an account of the origin of the polysporous condition, the different genera and species exhibiting this feature, and a system of classifying the different types of polyspory, i.e. true polyspory, dissociation of multicellular spores, and ascosporous conidia. F. L. S.

Sexuality.—R. VANDENDRIES ("Les tendances sexuelles des Polyporés," *Bull. Soc. Myc. Fr.*, 1936, **52**, 353-63, 13 figs.). An account of the sexual relations of *Melanopus squamosus*. This species is heterothallic and probably bipolar. The haploid and diploid mycelia form oidia and chlamydospores which, on germination, reproduce the haploid and diploid phases respectively. F. L. S.

Asiatic Fungi.—A. PILAT ("Additamenta ad floram Sibiriae Asiæ Centralis orientalisque mycologicam," *Bull. Soc. Myc. Fr.*, 1936, **52**, 300–37, 7 pls.). In this paper, which forms the fourth part of Pilat's additions to the flora of Asia, two Ascomycetes, one Hyphomycete, and about a hundred Basidiomycetes are described or recorded. The Basidiomycetes include two new genera and species: *Donkia pulcherrima*, based on *Hydnum pulcherrimum* Berk. and Bert., and *Porostereum phellodendri*. The plates consist of photographs of fruit bodies, while included in the text are thirty-nine drawings of spores, basidia, and hymenia. F. L. S.

Balkan Fungi.—A. PILAT ("Contribution à la Connaissance des Basidiomycètes de la Péninsule des Balkans," *Bull. Soc. Myc. Fr.*, 1937, **53**, 81–105, 5 pls.). In this list of Basidiomycetes from the Balkans the following species are described for the first time: *Crepidotus serbicus*, *Leptoporus bulgaricus*, *Leptoporus dalmaticus*, *Ptychogaster Lindtneri*, *Stereum sponheimeri*, *Gloeocystidium Lindtneri*, *Peniophora Lindtneri*, and *P. Hilizeri*. F. L. S.

Gold Coast Fungi.—H. A. DADE ("New Gold Coast Fungi," *Trans. Brit. Myc. Soc.*, 1937, **21**, 16–29, 4 figs.). The fungi described are *Thielavia setosa* n.sp., found growing over the aerial growths of mixed fungus cultures on cacao beans, and characterized by the presence of well-developed appendages on the ascocarps and by very large ascospores; *Syncephalis nana* n.sp., parasitic on *Absidia Regneri* growing on cacao beans; *Mucor inaequisporus* n.sp., which formed an orange-yellow growth on ripe fallen fruits of *Spondias mombin*; and *Absidia cristata* n.sp., saprophytic on Cassava stems and on fermented cacao. F. L. S.

Jura Fungi.—M. P. KONRAD ("Notes Critiques sur Quelques Champignons du Jura," *Bull. Soc. Myc. Fr.*, 1936, **52**, 35–54). This is the sixth and final part of a series of notes on fungi from the Jura. Here are detailed accounts of thirteen species distributed among the genera *Flammula*, *Clitocybe*, *Lepista*, and *Hygrophorus*. F. L. S.

Lichens.

Lichen-Flora of the Danzig District.—F. MATTICK ("Flechtenvegetation und Flechtenflora des Gebietes der Freien Stadt Danzig," **59**. *Bericht d. Westpreuss. Bot.-Zool. Vereins*, 1937, 1–54, 3 pls.). In the first part of this paper an account is given of the types of lichen-vegetation occurring in the various regions around Danzig, prefaced by a brief historical sketch of the development of systematic lichenology in Eastern Prussia. The various lichen-associations encountered are enumerated; of particular interest is the abundant occurrence of *Lecidea uliginosa* var. *chthonoblastes* on the sand-dunes, where it plays a conspicuous part in binding the sand and preparing the way for higher vegetation. A list of all the lichen-species known from the Danzig district forms the second part of the paper; they number 232, not including varieties and forms. Danzig lies approximately on the boundary between the oceanic and the continental climatic regions, and the lichen-flora correspondingly contains species characteristic of both these elements. Montane species, common to the Central European Alps and Scandinavia, are well represented; many of them are regarded as glacial relicts. I. M. L.

Lichens of Bavaria.—J. HILLMANN ("Beiträge zur Flechtenflora Bayerns. II," *Ber. d. Bayer. Bot. Ges.*, 1937, **22**, 1–16). A systematic enumeration of lichens observed chiefly by the author himself in the Bavarian Allgäu; 161 species are listed. I. M. L.

Lichenography of Thüringen.—H. SCHINDLER ("Flechtenflora von Rudolstadt. Ein Beitrag zur Lichenographie von Thüringen," *Beih. Bot. Centralbl.*, 1937, **56**, Abt. B, 327–52). A list of 198 species, of which several are new to Thüringen. Short critical notes are also given for many of the species, including observations on the reactions produced with the reagent paraphenylenediamine introduced by Asahina. I. M. L.

The Distribution of *Buellia canescens* in Germany.—H. SCHINDLER ("Beiträge zur Geographie der Flechten. II. Die Verbreitung von *Buellia canescens* De Ntrs. in Deutschland," *Ber. d. Deutsch. Bot. Ges.*, 1937, **55**, 226–35, 2 figs.). *Buellia canescens* is known to be a "western" or "atlantic" species. This is borne out by a study of its distribution in Germany, where it is common in the "oceanic" regions of the north-west, less common in the central "sub-oceanic" regions, and very rare in the "continental" part lying to the extreme south and east. Only in the "oceanic" regions does the lichen appear capable of colonizing bark; elsewhere it has been found solely on rocks. I. M. L.

Lichens in the Plant-associations of Mark Brandenburg.—H. KRIEGER ("Die Flechtenreichen Pflanzengesellschaften der Mark Brandenburg," *Beih. Bot. Centralbl.*, 1937, **57**, Abt. B, 1–76, 17 figs., 4 pls.). Certain plant-associations met with in the Mark Brandenburg are striking on account of the important part which lichens play in them. They are the associations of dry, acid, sandy soils, supporting little in the way of vegetation apart from trees and lichens. The chief lichens occurring in such associations are: *Cornicularia tenuissima* and a number of *Cladonia*-species, notably *Cl. mitis*, *Cl. sylvatica*, *Cl. rangiferina*, *Cl. impeza*, *Cl. tenuis*, *Cl. gracilis*, *Cl. furcata*, *Cl. destriata*, *Cl. bacillaris*, and *Cl. uncalis*. Many of these *Cladonia*-species form associations with *Pinus sylvestris*. Light was found to be an important ecological factor in determining the distribution of many of the lichens studied; *Cladonia sylvatica* and *Cl. rangiferina*, for instance, appear to have quite different optimal values for illumination. I. M. L.

Studies on Italian Lichens.—M. CENGIA SAMBO ("I Licheni della Conca di Tesino (Studio ecologico-fitogeografico)," *Rivista della Soc. di Studi per la Venezia Tridentina*, 1937, **18**, 123–231, 1 pl., 1 map). The region dealt with is the Conca di Tesino, in S.E. Trento. Both macroclimatic and microclimatic factors influencing the distribution of the lichens were studied. Of these factors humidity is the most important. The influence of the substratum was also of great importance, but could in certain circumstances be considerably modified or even nullified by the climatic factors. 222 species of lichens are listed. I. M. L.

The Lichen-floras of Southern Spain and Morocco.—R. G. WERNER ("Recherches phytogéographiques comparées sur la flore cryptogamique de l'Espagne méridionale et du Maroc," *Bull. Soc. Sci. Nat. Maroc*, 1937, **17**, 32–66). A close affinity exists between the phanerogamic and bryophytic floras of Southern Spain and Morocco, and the author demonstrates a similar correspondence in the lichens studied by him in both these regions. Some species, formerly regarded as endemic to Morocco, were found to occur in similar environments in Andalusia. 159 species of lichens are listed, of which five, in addition to two varieties and four forms, are new to science; a new species of lichen-parasite, *Didymella Weilli* Werner, is also described for the first time. I. M. L.

Morphology of Athalline Lichens.—E. BACHMANN ("Das Lager Athalliner Flechten," *Ber. d. Deutsch. Bot. Ges.*, 1937, **55**, 59–66, 1 pl.). The term "athalline

lichen " is in reality a misnomer, for every lichen must have a thallus, although in the case of many calcicolous lichens it is so deeply sunk in the substratum as to be demonstrable only by special methods. In *Catillaria athallina* (Hepp) Hellb. the thallus is represented macroscopically by a few diffract, irregular, pillar-like granules scattered among the apothecia. By treating a fragment of the substratum with dilute nitric acid the calcareous matrix may be dissolved away, leaving the lichen-thallus as a thin film, which can then be imbedded and microtomed in the usual manner. By this means it was seen that an extensive mycelium was present, linking up the smaller or larger thalline bodies in the form of an irregular network. In addition to this more or less superficial mycelium, a well-developed system of immersed spheroid cells was found to be present; morphologically this mycelium of spheroid cells is equivalent to the medulla in epilithic thalli, and consists of hyphæ with spherical thin-walled oil-filled articles. *Catillaria subnitida* Hellb., another "athalline" calcicolous species, shows simpler structure, for here no spheroid cell mycelium is developed. In the case of silicicolous lichens the thallus is always superficial, at most only a few rooting hyphæ penetrate into the cracks of the substratum. Here again the visible thallus can be much reduced, but is never entirely wanting.

I. M. L.

Thalline Cortex and Lichen-acids as Systematic Criteria in *Cladonia*.

—R. WEISE ("Betrachtungen über die Bedeutung des Thallusmantels und der Flechtensäuren für den Artbegriff in der Gattung *Cladonia*," *Ber. d. Deutsch. Bot. Ges.*, 1937, 55, 92–104). The author has shown in a previous paper (*Hedwigia*, 1936, 76, 179–188) that the podetia of *Cladonia* are first formed as cylindrical outgrowths consisting of hyphæ only, and subsequently acquire from external sources a more or less even coating of gonidial algæ, which form the outer cortical layer. The nature of this cortical layer is a criterion of considerable importance in the delimitation of species within this genus, as is also the chemical constitution as determined by taste and the use of reagents. Since the podetial gonidia must be obtained from external sources, it is obvious that algæ of very diverse physiological nature may be incorporated in the cortex of the growing podetium, and discrepancy between the growth-rates of fungal tissue and algæ may be the cause of variation in the consistency of the outer layer. The characteristic lichen-acids are joint products of the fungal and algal constituents, and it has not yet been discovered whether the presence of a strange alga as gonidium can induce a lichen to form chemical products different from those which characterize its normal state. That algæ other than the normal gonidia can be taken up in symbiotic relationship is shown by the occurrence of cephalodia. The author succeeded in transferring gonidia obtained from *Parmelia physodes* to the young, still purely hyphal podetia of *Cladonia gracilis*, where they were accepted and employed to form the cortical layer; unfortunately the cultures were not sufficiently advanced at the time of writing to determine whether the outer coat thus produced was that typical of the species. Comparative tests of the chemical reaction of podetia and basal thallus in a large number of herbarium specimens showed that in all cases the lichen acid present was the same in both parts; this does not prove, however, that foreign algæ incorporated in the podetia have no effect on the chemical substance produced, but may be due to the preponderating influence of the normal gonidia of the basal thallus in the formation of the characteristic lichen-acid. Further work on the origin of lichen-acids in the thallus and the influence of the algal components in determining their composition will be necessary before the problems outlined in the author's present study can be solved.

I. M. L.

The Identity of *Dendriscoaulon bolacinum* Nyl.—R. DUGHI ("Étude comparée du *Dendriscoaulon bolacinum* Nyl. et de la céphalodie fruticuleuse du *Ricasolia amplissima* (Scop.) Leight.," *Bull. Soc. Bot. France*, 1936, **83**, 671-93, 1 pl.). Several authors have at various times suspected that the fruticulose cephalodium of *Ricasolia amplissima* (Scop.) Leight is identical with the free-living lichen-growth known as *Dendriscoaulon bolacinum* Nyl. The cephalodia of the former commence on the underside of the thallus, and working up through the medulla, finally emerge and take on fruticulose form on the upper side. The *Nostoc*-algæ of the cephalodia are bright green in colour while within the medulla of the thallus, and only later, when the cephalodium including them becomes erumpent, take on the characteristic blue-green coloration. Numerous heterocysts are present. Latterly the algæ tend to become aggregated in the upper part of the cephalodium, light apparently being the causal factor in this segregation. A gelatinous sheath encloses the blue-green algæ, which must hence be regarded as *Nostoc*, and not *Anabarna*; however, in some parts these sheaths may be much reduced or even absent. The medullary hyphæ of the fruticulose cephalodia differ from those of the normal thallus in lacking an incrustation of crystals, probably calcium oxalate, an interesting indication of the change in metabolism induced by the presence of the different gonidial alga. Occasionally detached cephalodia were found growing upon the surface of the *Ricasolia* thallus, but without any genetic connection with the latter. The detailed comparative investigations of the two organisms made by the author fully confirms the claim that they are identical. I. M. L.

TECHNICAL MICROSCOPY.

Ultra-Violet Light and Photomicrography in Study of Animal Skin.—

E. R. THEIS and E. J. SERFASS (*J. Amer. Leather Chem. Assoc.*, 1938, **33**, 67). The advantages of transmitted ultra-violet light (3650 Å.) as an aid in the resolution of finer structural detail of animal skin is shown. The primary fluorescence of oils is shown, and use is made of this property for the determination of the penetration of fat-liquor (oil emulsion) into leather. The value of ultra-violet light as an illuminant for the study of the distribution of natural and added fat in an animal skin is indicated. Secondary fluorescence obtained by dark-field ultra-violet illumination and special stains is used to show the decomposition of the stratum germinatum of calfskins during processing, and also to show the presence of the hyaline layer and its disappearance during processing. Comparative photographs taken with both white and ultra-violet light are given to show the value of the latter as an aid in distinguishing details not ordinarily visible. A. H.

Precision All-Purpose Microcamera.—L. C. GRATON and E. B. DANE, Jr. (*J.O.S.A.*, **27**, November, 1937, 355–76). A photomicrographic apparatus of very heavy and rigid construction is described which permits of visual and photographic work at high magnifications with either incident or transmitted ordinary or polarized light. This apparatus, which weighs very nearly a ton, departs widely from conventional design; in particular it has a precision motor-driven fine-focusing mechanism which is one hundred times slower than on an ordinary microscope. One scale division on the fine adjustment equals 10 $m\mu$. On specially chosen objects, with a magnification of 3175 diameters, changes of focus of 100 $m\mu$ and a coloured structure 107 $m\mu$ wide, have been recorded photographically. The authors suggest that, as present microscope objectives apparently surpass the theoretical limits of resolution, existing microscopical theory may need review. E. E. J.

NOTICES OF NEW BOOKS.

The Chromosomes.—By M. J. D. WHITE. Methuen's Monographs on Biological Subjects: Methuen & Co., Ltd., London, 1937. vi+128 pp., 20 figs. Price 3s. 6d.

This book deals with the cytology and behaviour of the chromosomes in the course of mitotic and meiotic divisions, to each of which are devoted two chapters, preceded by one dealing with these elements in the resting nucleus. In the concluding section the author discusses the rôle of the chromosomes in the process of evolution and species-formation. The text is illustrated by a series of well-designed diagrammatic figures, and contains a glossary and a list of references.

This book is intended primarily for those biologists who do not specialize in cytology and are not in a position to follow the latest developments of our knowledge in this field. It serves this purpose admirably and gives a concise and lucid account of all the essential phenomena connected with the chromosomes which are of interest to the morphologist, geneticist, and systematist.

C. A. H.

OBITUARY.

ALFRED BARTON RENDLE.

(1865–1938.)

ALFRED BARTON RENDLE, who died at his home at Fetcham Park, Leatherhead, on January 11th, 1938, was one of our leading systematic botanists. In December last he went, as a delegate of the British Association, to attend the twenty-fifth session of the Indian Science Congress Association at Calcutta. On arriving at Bombay his health necessitated his return to England; he passed peacefully away just three days after reaching home and a few days before his seventy-third birthday.

Dr. Rendle was born in London on January 19th, 1865, and was educated at St. Olave's School, Southwark, and St. John's College, Cambridge. He graduated B.A. in 1887, proceeding M.A., 1891; of London University he was B.Sc. in 1887 and D.Sc., 1898. At Cambridge he came under the influence of S. H. Vines, and his interest in botany, already aroused at an earlier date, led to his choosing it as a career. In 1888 he was appointed assistant under William Carruthers in the Department of Botany at the British Museum (Natural History). He was Keeper of the Department from 1906–30. Here he found full scope for his leaning towards systematic botany, and the department and those who use it have benefited by his ability.

For many years he lectured in botany at the Birkbeck Institute and at the Royal Horticultural Society, and from the latter he received its Victoria Medal of Honour in 1917 and the Veitch Memorial Medal in 1929. He was President of the South London Botanical Institute in direct succession to its founder, A. O. Hume, who died in 1912. Dr. Rendle was also President of the Quekett Microscopical Club during the years 1917–21.

Early in the year following the Presidency of William Carruthers (1900–1901), A. W. Bennett, the Editor of the *Journal of the Royal Microscopical Society*, died, and Dr. Rendle joined the Editorial Committee. His name appears for the first time on the title-page of the volume for 1902. From that date onwards until the time of his death, a period of thirty-five years, he was responsible for the Abstracts of Botanical Literature published in our Journal. In recognition of his distinguished services to the Society he was elected to the Honorary Fellowship in 1923.

Dr. Rendle's publications in systematic botany are too numerous to give

in detail, but mention may be made of the "Classification of Flowering Plants," Vol. 1 of which was issued in 1904 (2nd edition, 1930) and Vol. 2 in 1925. He was editor of the *Journal of Botany* from 1924 until 1938 and a contributor ever since 1891. He also prepared the second edition of Britten and Boulger's "Biographical Index of British and Irish Botanists," 1931.

In 1888 Rendle became a Fellow of the Linnean Society, and served on the Council for three periods—he was botanical secretary from 1916 to 1923 and president from 1923–7. He was elected F.R.S. in 1909.

Attracted to the meetings of the British Association he had much to do in organizing the visits to Canada, Australia, and South Africa. These visits gave him the opportunity of extending his botanical knowledge of the floras and vegetation of the places visited. After his retirement he made an extended visit to Jamaica and Bermuda, bringing back many specimens which were intended for work on the completion of the "Flora of Jamaica," of which five volumes had been published. This "Flora" originated in collaboration with William Fawcett, who died in 1926, and Rendle undertook the completion of the seven volumes contemplated.

Among the wide range of subjects in which Rendle was interested was one he had very much at heart and which received his cordial support and collaboration—the protection of the rarer members of the British flora. He was ever found sympathetic and helpful to those who sought his aid on botanical questions, and the information was conveyed in a simple and happy manner which was very attractive.

A. W. SHEPPARD.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, B.M.A. HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, DECEMBER 15TH, 1937, AT 5.30 P.M., DR. R. S. CLAY, B.A., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Sterling Louis Calhoun.	Cleveland, Ohio.
M. A. A. Nomani.	Lucknow.
George Buckham Reilly.	Sheffield.

Nomination Certificates in favour of the following candidates were read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

Glenn S. Moore, M.D., B.Sc.	Chicago.
H. Moore, D.Sc., A.R.C.S., F.Inst.P.	Huyton.

Deaths.—The President announced the regrettable loss to the Society, by death, of the following Fellows :—

E. T. Browne.	Elected 1887.
H. Crowther.	„ 1891.
E. Goddefroy.	„ 1928.

The Fellows signified their condolence with the relatives by standing in silence.

Donations were reported from :—

Société Hollandaise des Sciences—

“Œuvres Complètes de Christiaan Huygens. XIX. Mécanique, Théorique et Physique de 1666 à 1695.”

Dr. L. P. Clarke, F.R.M.S.—

4 objectives on quadruple nose-piece by Carl Zeiss.

Syndics of the Cambridge University Press—

“The Structure and Development of the Fungi.” Second Edition.
By H. C. I. Gwynne-Vaughan and B. Barnes.

Votes of thanks were accorded to the donors.

New Council.—Nominations to serve on the Council for the ensuing year, for election at the Annual Meeting, were read and approved.

Paper.—The following communication was read and discussed :—

E. Heron-Allen, F.R.S., F.R.M.S.—

“The Protoplasm and Pseudopodia of the Foraminifera.”

A vote of thanks was accorded to the author of the foregoing communication.

Announcements.—The Secretary made the following announcements :—

The Rooms of the Society will be closed from December 23rd to December 28th, 1937.

The Biological Section will meet in the Pillar Room on Wednesday, January, 5th, 1938.

The Annual General Meeting of the Society will be held on Wednesday, January 19th, 1938, when Dr. R. S. Clay, B.A., F.Inst.P., P.R.M.S., will deliver his Presidential Address.

The Proceedings then terminated.

THE ANNUAL GENERAL MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, B.M.A. HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, JANUARY 19TH, 1938, AT 5.30 P.M.,
DR. R. S. CLAY, B.A., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Glenn S. Moore, M.D., B.Sc.

Chicago.

H. Moore, D.Sc., A.R.C.S., F.Inst.P.

Huyton.

Nomination Certificate in favour of the following candidate was read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

J. D. Hegerty.

Jerusalem.

Death.—The President announced the regrettable loss to the Society, by death, of the following Honorary Fellow :—

Dr. A. B. Rendle.

Elected 1923.

The Fellows signified their condolence with the relatives by standing in silence.

Donation was reported from :—

R. & J. Beck, Ltd.—

“ The Microscope : Theory and Practice.” By Conrad Beck.

A vote of thanks was accorded to the donors.

The Annual Report of the Council for the year 1937 was read by the Secretary as follows :—

NINETY-EIGHTH ANNUAL REPORT.

REPORT OF THE COUNCIL FOR THE YEAR 1937.

FELLOWS.

The Council deplores the loss the Society has sustained during the year, by death, of the following Fellows :—

E. T. Browne	Elected 1887.
A. S. Burgess.	„ 1920.
H. Crowther.	„ 1891.
S. E. Dowdy.	„ 1907.
E. Goddefroy.	„ 1928.
Elmer E. Hägler.	„ 1893.
A. Gandolfi Hornyold.	„ 1920.
J. J. Schoonhoven.	„ 1925.
H. F. Springall.	„ 1918.

Twelve Fellows have resigned and eleven have been removed from the Roll of Fellowship under By-Law 31.

One has been reinstated under By-Law 32, and thirty-two new Fellows have been elected.

MEETINGS.

Eight meetings of the Council and eight Ordinary Meetings of Fellows have been held in the Rooms of the Society, and the attendances have been well maintained.

JOURNAL.

The scientific proceedings and transactions of the Society have been published as usual in the Society's Journal in addition to the comprehensive series of abstracts of current English and foreign periodical publications bearing on microscopy and its applications in science and in industry.

The Journal continues to enjoy world-wide circulation, despite the embarrassing currency difficulties of many foreign libraries and research institutions.

The thanks of the Fellows are due to the Editor, Dr. G. M. Findlay, and to the Panel of Abstractors for their unremitting and valued services to the Society.

LIBRARY.

Fifty-three volumes, including several important accessions, have been added to the Library during the past year, which have been duly reported in the Society's Proceedings, and the thanks of the Fellows have been conveyed to the following donors: Dr. R. St. John Brooks, Cambridge University Press, Mrs. Chaston Chapman, Messrs. Chapman & Hall, Messrs. J. & A. Churchill, Ltd., Mr. A. Earland, Mr. N. Ingram Hendey, Prof. R. Tanner Hewlett, MM. Paul Lechevalier et Fils, Messrs. Longmans, Green & Co., Ltd., Messrs. Macmillan & Co., Ltd., Messrs. Methuen & Co., Ltd., Mr. E. G. Miller, Oxford University Press, Mrs. J. Wilson Potter, Mr. P. K. Sartory, Mr. C. D. Soar, Société Hollandaise des Sciences, Messrs. Taylor & Francis, Ltd., and Trustees of the British Museum.

In addition to the works consulted by visitors to the Library, one hundred and seventy-eight volumes have been borrowed therefrom and a further ten volumes obtained from the National Central Library for the use of Fellows. Twenty-two volumes have also been lent to the National Central Library.

INSTRUMENTS AND APPARATUS.

The Curator of the Society's Collection reports that during the past year the instruments contained in the exhibition case in the Hastings Hall have been examined and thoroughly cleaned and are now in good condition.

The more important items in the case in the Secretary's office have also been dealt with. There is very little space available there, however, and it is difficult at present to arrange these instruments in an orderly manner.

The Register has been brought up to date.

The microscope bequeathed to the Society by the late Dr. A. S. Burgess has been put into good working order by Mr. Beck and is a welcome addition to the stands available for use at the Meetings; but there is still a shortage of modern instruments in the Society's Collection, and it is felt that if this could be remedied to some extent encouragement would be given to the exhibition of interesting specimens at the Society's meetings.

Accessions to the Society's Collection since the last Annual Report are noted below:—

H. G. Williams, F.R.M.S.—

5 dissecting lenses in case, c. 1850.

A Zeiss Abbé condenser.

H. Taverner, F.R.M.S.—

1851 Exhibition binocular microscope and accessories in case, by R. & J. Beck.

A Nernst lamp.

Professor W. Bulloch, F.R.S.—

1/50th Powell & Lealand objective.

P. K. Sartory, F.R.M.S.—

A portable microscope with accessories in case, by Cary, c. 1827.

Executors to the estate of the late Dr. A. S. Burgess.—

A Zeiss microscope, 8 eyepieces, 10 objectives, and miscellaneous microscopical accessories.

A. S. Newman, F.R.M.S.—

A Dollond microscope and accessories in case, c. 1790.

Mrs. Chaston Chapman—

A Dollond double reflecting microscope, c. 1758, with accessories and leaflet in case.

F. Edwin Allen—

A drum microscope signed S. & B. Solomons, c. 1840, with accessories in case.

F. W. Mills, F.R.M.S.—

A small French microscope in case, c. 1879.

Dr. L. P. Clarke, F.R.M.S.—

4 objectives on quadruple nose-piece by Carl Zeiss.

SLIDE CABINET.

The Curator of Slides reports that the reorganization of the Society's Collection of slides continues and the section devoted to diatoms now constitutes a valuable herbarium of reference to workers in that subject. It is to be deplored that the Society's Collection lacks representative specimens of sands, clays, cements, and such new building materials as are in use at the present time, as it is felt that the Society's interest should extend to the technical problems occasioned by these materials. The Curator would be glad to receive any slides of such materials for the Society's Collection.

During the past year the following accessions have been added to the cabinet : 18 species slides of diatoms from the Rev. Dingley P. Fuge ; 58 species slides of diatoms from Mr. John A. Long ; 7 micro-slides of geometrical rulings from Mr. Frank Rowley ; and a collection of micro-slides of eggs of Mallophaga, mounted by the late F. W. Millett, from Mr. Arthur Earland. It should be noted that a collection of original water-colour drawings by Millett of these latter slides has also been presented by Mr. Earland to the Society's Library.

The importance of the Society's cabinet as a standard reference collection is exemplified by the constant demand made upon it by interested bodies, and it behoves the Fellows to make the collection of slides as complete as possible.

GENERAL.

The use of the Society's table at the Marine Biological Laboratory, Plymouth, was granted during the year to Mr. Paul R. Crimp and to Mr. N. Ingram Hendey.

THE SOCIETY'S CENTENARY.

The Council takes this opportunity of calling the attention of the Fellows to the fact that the Society celebrates its Centenary Meeting in 1939. The Council appointed a Committee to consider ways and means of celebrating the occasion and to make recommendations thereon, and the following is a brief summary of a report received from that Committee :—

DATE AND DURATION—

It is proposed that the appropriate date for the meeting would be October 1939 and that the meeting should last for two days, one for formal business and communications and one informal and conversazione.

EXHIBITION—

That an exhibition of historical instruments (as many as possible set up to show the successive improvement in performance), together with Fellows' exhibits, should be held.

PUBLICATION—

It is recommended that the December issue of the Society's Journal for 1939 should be a Centenary Number containing, in addition to papers communicated, the President's historical address and description of the Centenary Meeting and exhibits ; pagination to be continuous.

GUESTS—

The Committee suggests that British and foreign institutions be invited to be represented by delegates resident in or visiting London at the time of the Society's Centenary Meeting.

FINANCE—

The printing cost of the Journal in the Centenary year will be heavy, and it is assumed that this will be met out of the Society's funds.

With regard to the expenses of the meeting, the Committee recommends that a guarantee fund be raised and that the sum of £100 be reserved in the Society's accounts to meet contingent liabilities.

A full report of the Committee's recommendations will be issued at an early date and the Council relies upon the loyal support and co-operation of the Fellows to ensure the success of this historic occasion.

APPENDIX.

BIOLOGICAL SECTION.

The Biological Section held its usual seven meetings in the Pillar Room during the year. The attendance ranged from fifteen to thirty, with an average of just over twenty, which is about the same as in recent years. The communications, as usual, covered a wide range of subjects and the discussions thereon and upon the miscellaneous exhibits were usually of a very interesting and instructive character. No visits to the laboratories of other societies and institutions were made during the year.

On the motion of Mr. M. Blood, seconded by Mr. C. H. Bartlett, the following resolution was carried unanimously :—

“ That the Annual Report be received and adopted.”

It was further resolved, on the motion of Mr. A. W. Sheppard, seconded by Mr. J. T. Holder :—

“ That a hearty vote of thanks be tendered to the Officers and Members of Council for their services during the past year.”

Carried with acclamation. Mr. J. Smiles responded.

New Council.—The President appointed Mr. A. J. Bowtell and Mr. F. C. Grigg to act as Scrutineers of the ballot for the election of Officers and Members of Council for the ensuing year ; subsequently, upon receipt of the Scrutineers' report, the result of the ballot was declared from the Chair as follows :—

President.—J. E. Barnard, F.R.S., F.Inst.P.

Vice-Presidents.—R. S. Clay, B.A., D.Sc., F.Inst.P. ; M. T. Denne, O.B.E., A.Inst.P. ; R. Ruggles Gates, M.A., Ph.D., LL.D., F.R.S., F.L.S. ; E. E. Jelley, D.Sc., F.I.C., F.R.P.S.

Hon. Treasurer.—C. F. Hill, M.Inst.M.M., A.Inst.P.

Hon. Secretaries.—R. T. Hewlett, M.D., F.R.C.P., D.P.H. ; J. Smiles, A.R.C.S.

Ordinary Members of Council.—Conrad Beck, C.B.E. ; R. J. Bracey, F.Inst.P. ; G. M. Findlay, C.B.E., M.D., D.Sc. ; N. Ingram Hendey, M.P.S., F.L.S. ; Andrew More, I.S.O., A.R.C.S., F.I.C. ; J. A. Murray, M.D., F.R.S. ; A. S. Newman, F.R.P.S. ; J. H. Pledge ; D. J. Scourfield, I.S.O., F.I.S., F.Z.S. ; T. E. Wallis, B.Sc., Ph.C., F.I.C. ; H. Wrighton, B.Met. ; S. R. Wycherley.

Hon. Editor.—G. M. Findlay, C.B.E., M.D., D.Sc.

Hon. Librarian.—Clarence Tierney, D.Sc., F.L.S.

Hon. Curator of Instruments.—M. T. Denne, O.B.E., A.Inst.P.

Hon. Curator of Slides.—N. Ingram Hendey, M.P.S., F.L.S.

On the motion of the President, a hearty vote of thanks was accorded to the Scrutineers for their services.

Presidential Address.—Dr. R. S. Clay, B.A., then delivered his Presidential Address on :—

“ A Review of the Mechanical Improvements of Microscopes in the last Forty Years,” at the conclusion of which and on the motion of Mr. J. E. Barnard, seconded by Mr. J. G. Bradbury, the following resolution was carried with acclamation :—

“ That the best thanks of this Meeting be accorded to Dr. R. S. Clay for his Presidential Address, and that he be asked to allow it to be printed in the Journal of the Society.”

The President responded.

Announcement.—The Secretary made the following announcement :—

The Biological Section will meet in the Pillar Room on Wednesday, February 2nd, 1938.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, B.M.A. HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, FEBRUARY 16TH, 1938, AT 5.30 P.M., MR. J. E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding meeting were read, confirmed, and signed by the President.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

J. D. Hegerty.

Jerusalem.

Nomination Certificates in favour of the following candidates were read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

Robert Ross, B.A.

London.

C. S. Todd.

Camberley.

Death.—The President announced the regrettable loss to the Society, by death, of the following Fellow :—

Mah Nomani.

Elected 1924.

Donations were reported from :—

R. & J. Beck, Ltd.—

“Instructions for the Use of the Beck Microscope.”

J. & A. Churchill, Ltd.—

“Recent Advances in Cytology.” By C. D. Darlington. Second Edition.

C. H. Bartlett, F.R.M.S.—

Two Guineas (£2 2s.).

Votes of thanks were accorded to the donors.

Paper.—The following communication was read and discussed :—

J. M. Preston, B.Sc., A.I.C., F.R.M.S., and S. Hopkinson, A.M.C.T.

“ The Determination of Photomicrographic Exposures.”

Exhibit.—Mr. Mansell P. Swift exhibited and described two new types of high-power binocular microscopes.

Votes of thanks were accorded to Mr. Preston for his communication and to Mr. Swift for his exhibit.

Announcement.—The Secretary made the following announcement :—

The Biological Section will meet in the Pillar Room on Wednesday, March 2nd, 1938.

The Proceedings then terminated.

JOURNAL OF THE ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1938.

TRANSACTIONS OF THE SOCIETY.

IV.—THE STRUCTURE OF THE CHROMOSOME.*

By R. RUGGLES GATES, F.R.S.

(Read April 20th, 1938.)

IN all fields of scientific research two opposing schools of thought are frequently found; but, owing perhaps to the numerous sources of error in technique and in observation, this condition appears to be more characteristic of cytology than of most other branches of investigation. Nevertheless, great advances in our understanding of nuclear structure have continually taken place, and our knowledge of chromosome structure has been almost entirely developed and organized during the last thirty years. Perhaps the most striking contradictions at the moment are with regard to (1) the chromomere *vs.* the chromonema hypothesis, and (2) the time of splitting of the chromosome, as well as the number of threads it contains.

The chromomere hypothesis of chromosome structure fitted in so well with the conception of genes that it was almost inevitable that many observers, finding an appearance of granules on the thread, should adopt them as realities without looking too critically into the numerous possible sources of such an appearance. Belling (e.g., 1931) was perhaps the most enthusiastic sketcher and counter of chromomeres in pollen mother-cells. But improved methods of fixation and staining have led many investigators of plant chromosomes to recognize the chromonema as a spiral thread of uniform thickness and staining properties. The large and beautiful spirals of *Trillium* chromosomes, as demonstrated, for example, in the papers of Huskins and Smith

* Presented at the 25th (Jubilee) Session of the Indian Science Congress, Calcutta, Jan. 9th., 1938.

(1935), Matsuura (1935), and Kato and Iwata (1935) are most convincing of all for the chromonema theory, although Huskins and Smith also figure chromomeres in the leptotene and zygotene stages. The chromosomes of many other plants can be seen to have the same spiral structure, as, for example, *Tradescantia* (Kuwada and Nakamura, 1935). After examining such clear uniform spirals one can only conclude that, in such chromosomes at any rate, chromomeres give no evidence of their presence. Darlington (1935) and many others have also described and figured such chromomeres. They well illustrate the peculiar temptation of cytologists to confuse objective observation with theoretical speculation. It is so easy to conclude that, since the gene theory recognizes discrete portions of the chromosome, the corresponding chromomeres must be there, and to accept at once observations which seem to indicate their presence. Many of us have been guilty of such procedure, but Darlington (1937) goes a step further and assumes that chromomeres must be present even if invisible, i.e. ultramicroscopic. This, however, is confusing the chromomere, a visible microscopic unit, with the gene, an invisible ultra-microscopic conception—an equivocal method of reasoning. Various errors of observation, technique, and interpretation lead to the false appearance of granules or chromomeres on a thread. The leptotene thread may appear moniliform, as Kaufmann (1931) and Koshy (1934) have pointed out, owing to two split halves being closely twisted around each other. A single fine spiral near the limits of resolution is easily mistaken for a row of "chromomeres." The unequal destaining of a fine spiral may easily result in such a picture, and there are various other sources of such an appearance. But recent careful work of Koshy (1933, 1937), Naithani (1937a), and many others leads to the conclusion that the chromosome consists of spiral threads of relatively uniform thickness in all stages of the mitotic cycle, the spiral becoming tightest in metaphase and loosest in interphase.

While it thus seems clear that many chromomeric appearances require different explanations, the true chromomere may still remain, and animal cytologists still frequently describe and figure them. It is well known that animal chromosomes are generally smaller than the plant chromosomes commonly used for chromosome studies, and that a fine spiral at the limits of visibility will appear as a row of granules. A recent paper of Nebel and Ruttle (1937) on meiosis in *Dissosteira*, an Orthoperan insect, adopts the usual convention of drawing chromomere-like bodies in some parts of the chromosomes, but in other parts of the same chromosome they are clearly shown as continuous uniform spirals. As will be considered later, these authors regard somatic chromosomes as 4-partite structures and figure the leptonema as quadripartite in plants (1936), but in *Dissosteira* they find the leptonema visible as two threads because the half-chromatids are so delicate that they cannot be resolved. Warmke (1937) in *Trillium* finds similarly that, while the anaphase and telophase chromosomes are composed of two chromonemata with relational coiling, yet the much more delicate leptotene threads

appear optically single although they must be genetically double. Such a result can also, of course, be produced by inadequacy of fixation or treatment.

Naithani (1937b) also finds the leptotene thread (in *Hyacinthus*) optically single, although he shows, as already mentioned, that the ordinary anaphase chromosomes consist of two intertwined chromonemata, while the metaphase chromosomes are quadripartite. Koshy (1937), on the other hand, finds the leptotene thread double in *Aloe* as well as in *Allium* (1934). Since the leptotene thread is so near the limits of resolution in many organisms, and since several workers (Kaufman, 1931; Robertson, 1931; Nebel, 1932; Dermen, 1936; Atwood, 1937) have shown that the chromosomes in the last pre-meiotic telophase are split as in other telophases, it is more reasonable to suppose that the leptone-ma is structurally double although in some cases optically single, than to assume, with Darlington (1937), contrary to the great mass of other observational evidence, that the split in the leptone-ma is really suppressed. Of course, this upsets many of his theories of meiosis and mitosis, but that is characteristic of the progress of cytology.

To return to the chromomeres of animal chromosomes, Wenrich's (1916) well-known paper on *Phrynotettix* has often been quoted and his figures of chromomeres of various sizes lying at different but fixed intervals along the length of the chromosomes have often been copied. Although they seem convincing, it is unlikely that the large and small granules equally represent chromomeres. Subsequent progress in technique makes it desirable that this work be repeated with modern methods. This reassessment is all the more necessary because Wenrich also figures spirals in the same paper. Koller adheres to the classical method of representing zygotene and pachytene chromosomes as a double thread bearing paired granules, in marsupials (1936a) and in squirrels (1936b). If Koshy's interpretation of such moniliform appearances is applicable, then the pachytene nuclei in these papers may really have quadruple threads.

Recent results of Kaufmann and Demerec (1937) appear to favour the chromonema rather than the chromomere hypothesis of animal chromosome structure. These investigators X-rayed the sperm of *Drosophila* and studied the resulting breaks as they appeared in the salivary gland chromosomes of the offspring. They found these breaks to be equally distributed in the euchromatic and heterochromatic (genetically active and inactive) parts of the chromosomes, and they conclude that the chromosomes are all composed of a chromonema which is structurally similar throughout its length. They suggest that this axis of the chromosome may be composed of a number of parallel axes of protein molecules bearing groups of attached radicals corresponding to the genic material.*

Turning now to the time of splitting of the chromosomes in mitosis, here we have what appears at first to be a dilemma between those on the one hand

* Kostoff (1938) finds that *Triticum* chromosomes contain chromomeres which are more closely aggregated at the (inert) heterochromatic ends of the chromosome. He therefore concludes that the active genes must lie not in the chromomeres but between them. This view of the chromomeres is not, however, without its difficulties.

who conclude from X-ray experiments that the chromosomes split in the resting nucleus and are single in anaphase, and on the other hand the observers who find that the chromosomes are actually quadruple through a split at prometaphase and double in anaphase and telophase. But the contradiction is not so simple as this. In the first place there are the numerous observers who find the larger plant chromosomes to consist of four strands at metaphase and two intertwined chromonemata in anaphase or telophase or both. These include Dehorne (1911) on *Salamandra* and *Allium*, Kaufmann (1926), Sharp (1929), Hedayetullah (1931) on *Narcissus*, Perry (1932) on *Galanthus*, Koshy (1933) on *Allium* and (1937) on *Aloe*, Hoare (1934) on *Scilla*, Sax and Sax (1935) on several genera, and Naithani (1937a) on *Hyacinthus*. As regards animals, Dearing (1934) shows clearly in *Amblystoma* that the telophase chromosomes are double and that each nucleolus begins as two swellings which shortly fuse on the respective chromatids of a telophase chromosome.

In answer to those who insist that the chromosome split must be in the resting nucleus, contrary to the abundant optical evidence of double anaphase and telophase chromosomes, Naithani (1937a) has pointed out that in actively dividing meristems where there is no resting stage between mitoses the split must necessarily occur elsewhere in the mitotic cycle.

Some critical observations of the very large somatic metaphase and anaphase chromosomes of *Trillium sessile* very recently made in my Laboratory on preparations of Mr. Mensinkai lead to definite conclusions (Gates, 1937a).^{*} They leave no room for doubt that these chromosomes are composed of four chromonemata intertwined in pairs at metaphase, while the anaphase chromosomes contain two intertwined threads. Occasionally the two diverging ends of these threads can be clearly seen, but more often the chromonemata converge at the end of the chromosome and meet so as to form an essentially continuous rounded end to the chromosome. This apparently accounts for the difference between a normal chromosome-end, which maintains the unity of the chromosome, and the behaviour of the chromonemata, which rejoin after a break.

Before considering the nature of the evidence derived from X-ray experiments, it is necessary to refer to the views developed by Nebel and his school. They bring evidence, which cannot be lightly disregarded, in favour of the view that the chromosomes both in plants and animals are composed of four strands in prophase and anaphase, a further split occurring at metaphase of each mitotic cycle to give eight strands. Each chromatid would then be composed of two half-chromatids throughout the mitotic cycle. The evidence is contained in a series of papers, mainly on *Tradescantia*, by Nebel (1933a, 1933b, 1936, 1937) and Nebel and Ruttle (1936), but also on *Trillium*, *Hordeum*, and *Secale*. Dermen (1936) also finds the meiotic chromosomes of *Tradescantia* at first metaphase 8-parted. Nebel and Ruttle (1937) find the

^{*} Also Gates and Mensinkai, 1938.

same in *Dissosteira*, except that, as already mentioned, the leptotene thread is found to be so delicate that only its primary resolution into two strands can be observed. Goodspeed, Uber, and Avery (1935) find similar conditions in *Lilium* by using the Altmann freezing-drying technique. These results taken together, and supported by photomicrographs, yield evidence which may be difficult to controvert, although the weight of evidence is against them. Marshak (1936) has published photomicrographs showing the anaphase chromosomes of *Vicia* as containing "granules" which may be interpreted as arranged in four strands; but with the high magnification used on these relatively small chromosomes it is more likely that these are only diffraction patterns.

X-RAY EXPERIMENTS.

Coming now to the evidence from X-ray experiments, the results and their interpretations are at the moment hopelessly conflicting. Without going into the history of these experiments, it may be pointed out that all the authors appear to have interpreted their results successfully in terms of the views on chromosome structure which they already held, with the assumption in common that if the chromosome is double at the time of breakage by an X-ray only one of its chromatids will usually be affected. Mather and Stone (1933), irradiating root-tips of *Crocus*, concluded that the chromosomes split in the resting nucleus. Mather (1934), irradiating the pollen meiosis of *Tradescantia* and *Vicia*, emphasized the abundant fragmentation and the effect on chiasma formation. Huskins and Hunter (1935), using the pollen-grain mitosis in *Trillium*, which is free from the objections to root-tips, found breaks and translocations of chromatids as well as whole chromosomes. They also show clearly in this very favourable material that while the prophase chromosomes are double, the metaphase chromosomes are quadruple. From this work they concluded with apparent reason that the chromosomes in *Trillium* are double at all stages except metaphase, when they are 4-parted. White (1935) obtained rather inconclusive results from irradiating spermatogonia of *Locusta*. He found no evidence of a split in the anaphase chromosomes, but concluded that it is possible for both chromatids of a split chromosome to be broken at the same point by X-rays. Nebel (1936) irradiated the presynaptic stages of *Tradescantia* pollen mother-cells and studied the resulting meiotic divisions. He concluded that a low dosage of X-rays indicates that the presynaptic threads are double, while a higher dosage indicates that they are quadruple. Riley (1936) also subjected the anthers of *Tradescantia* to X-rays at various stages of pollen development and concluded that chromosome fragments derived from treatment of the prophase were chiefly unbalanced and that therefore the split was not until late in the resting stage.

That these contrary conclusions are due to insufficient knowledge of what actually happens to cells under X-ray treatment is shown by White (1937),

who finds that chromosomes are affected quite differently according to the stage of division of the nucleus. He concludes that the nuclear membrane protects the chromosomes in prophase from a direct hit, their disintegration being a general indirect effect of the production of some deleterious substance in the cytoplasm, and quite different from the fragmentation produced in metaphase and anaphase.

Recently Mather (1937) has returned to the subject, irradiating the pollen-grains of *Tradescantia* and two other plants and deriving the conclusion that the chromosomes split during the post-meiotic resting stage. This conclusion is based on the observation that up to 36 hours after treatment the breaks were mainly in chromatids, while in the following 36 hours they were mainly in whole chromosomes. Mather's interpretation is that at some time the chromosomes of the resting nucleus change "from a state in which they act as single to X-rays to a state in which they act as double." It is impossible, however, to suggest that these experimental results, in which the method of action of the X-rays is quite unknown in detail, negative the very clear direct evidence of 4-parted metaphase and 2-parted anaphase chromosomes, for example, in *Trillium* and *Tradescantia*.

Nebel (1937) has also subjected a fresh series of *Tradescantia* anthers to X-rays and other radiations, and has made a cytological study of the chromosome lesions subsequently observed in various meiotic stages, from fixations made for the most part between 24 and 72 hours after treatment. Although half-chromatid lesions are relatively rare, Nebel observed in ninety-two cases chromosome lesions which were "most readily interpreted as half-chromatid lesions of presynaptic chromosomes." It is therefore concluded that the presynaptic chromatid was split, i.e. that the leptotene thread was composed of four strands. Numerous minute fragments of chromatin were also observed, which were interpreted as detached half-chromatid fragments, and those observed by Mather are believed to have the same origin.

Thus it is clear that the results of X-ray experiments, even on the same material, are subject to the same differences of opinion as the results of direct observation. Darlington has endeavoured to solve the difficulty by denying the validity of all visual observations, including his own, when they are contrary to the theory of the chromosome as a single structure. At the same time he accepts the validity of his observations on the chiasmata and their formation, although these are the same threads which are involved in the structure of the chromosome: The denial of all observations which disagree with a particular preconception would reduce cytology to a pseudoscience. The idea that chromatin threads are below or above the limits of optical resolution according to whether they agree or disagree with a particular theory will not do. Every microscopist knows that it is impossible to reject all observations of chromosome threads on the grounds of failure of resolution. They must therefore be accepted as real, subject of course to the usual criticisms of method and interpretation.

Huskins (1937) has very recently produced further evidence that the

chromosomes of *Trillium erectum* are eight-stranded in first metaphase, and concludes that in somatic mitoses the chromosomes are at least longitudinally double structures. The leptotene threads are found to be optically single after various fixing and staining methods, although the pre-leptotene threads were clearly double.

Marshak (1936) supports Nebel in the view that the somatic chromosome is quadruple in anaphase and prophase, yet he differs in his conception of how the four strands are related to each other. While Nebel finds them running parallel, the majority of investigators have observed the strands twisted about each other. Marshak (1937) finds that in somatic telophase two chromonemata are visible, and at metaphase four, the division occurring "at the onset of prophase." But he concludes that the separation of the strands formed by this split occurs at the succeeding anaphase, not the second following anaphase. He thus (1936) endeavours to harmonize the two opposing views by supposing that the single coiled chromonemata of interphase give place at the onset of prophase to pairs of laterally associated coils, H_1 , which are also coiled about one another to form the H_2 helices. During prophase the H_1 coils increase in diameter and at metaphase each chromosome contains four helical chromonemata, the dimensions of which are measured. The anaphase chromosome then contains two helical chromonemata coiled about each other. The H_1 helices may be obliterated in certain fixations, which would result in the apparent interlacing of the H_2 helices. Marshak rightly, I think, emphasizes the matrix as an important part of the chromosome and its dissolution under certain conditions as producing significant changes in the arrangement of the chromonemata.

Ruttle and Nebel (1937) again conclude from recent observations of the somatic chromosomes of barley and rye that they are essentially quadruplicate at anaphase, telophase, interphase, and prophase, the threads (half-chromatids) existing as pairs of slender, parallel, narrow spirals during interphase, becoming reassociated during prophase. The preleptotene threads are found to be visibly double, but in leptotene they are so closely associated as to appear single.

From all the observations on chromosome structure we may conclude that anaphase and telophase chromosomes are certainly composed of two intertwined chromonemata, which are well above the limits of microscopical resolution in many chromosomes. Whether these are possibly in turn composed of split halves may be left to the future to determine. The present evidence for this view is unconvincing.

THE NUCLEOLUS AND SATELLITES.

One of the most important recent advances in our knowledge of nuclear structure has been in connection with the nucleoli and their origin from the satellited chromosomes. It appears that every primary diploid plant or animal generally has one pair of satellited chromosomes which, when they

lie near together, produce by fusion a single nucleolus. Kuhn (1928) concluded in *Thalictrum* that the monoploid species have one pair of chromosomes with satellites. However, Satô (1937) and Resende (1937a) have found certain diploid species ($2n=14$) of *Aloe* and *Gasteria* having three or four satellites and the corresponding number of nucleoli; and Marthaler (1936) finds that in *Petunia*, where $2n=14$, some plants have two SAT-chromosomes while others have three. If the principle that primary diploids have a single pair of SAT-chromosomes is of general application, it will be of great value in relating chromosome numbers to phylogeny. In a recent study of the chromosomes of the Crecpidinae, Babcock, Stebbins, and Jenkins (1937) figure the idiograms of many species of *Lactuca*, but they make no use of these satellites in the interpretation of the phylogeny. Four of the species of *Lactuca* figured have $2n=16$ chromosomes; three of these are shown as having four SAT-chromosomes, while one has only two. It therefore appears likely that these species are secondary tetraploids of amphidiploid origin and that *L. tenerrima* has since lost one pair of satellites. The small size of its chromosomes is also in harmony with the interpretation that it is more specialized than the others. Similarly, five of the species figured show $2n=18$. One of these, *L. viminea*, clearly has four very small satellites, perhaps indicating that all the satellites are diminishing together; *L. muralis* shows three and the fourth may be hidden; while *L. sibirica*, *L. virosa*, and *L. laciniata* show only two. Again it appears probable that 18 is a secondary tetraploid number, various species having since lost one pair of satellites. The evidence of the satellites therefore points to 16 and 18 as secondary tetraploid numbers in the subtribe Crecpidinae. On the other hand, Noack (1937) in a study of *Verbena* chromosomes, shows two pairs of SAT-chromosomes in *V. teucrioides* ($2n=10$), whereas *V. erinoides*, with the same number of chromosomes, has one pair of satellites. It remains to be seen whether 10 is a secondary polyploid number or how the genome of certain apparently diploid species comes to have two pairs of SAT-chromosomes.

In insects the satellited chromosome is quite generally the sex chromosome and the same is true of some liverworts with differentiated sex chromosomes. In such genera as *Haworthia* the satellites are very near the limits of visibility (Resende, 1936), which suggests that in certain other genera they may have fallen below the microscopic limit or disappeared altogether. In the small chromosomes of *Oryza*, which appear to be terminally attached to the nucleolus (Nandi, 1937), the satellite cannot be seen in somatic metaphase, and may either be sub-microscopic or absent altogether. Some careful observations of the nucleolus and satellite have been made by Dermen (1933).

The nucleolar body appears to be usually at the end of the chromosome proper, where the thread emerges which connects the chromosome with its satellite. In other words, in most genera one gene for nucleolus-production lies at this locus in every genome. There is at present no obvious reason why the nucleolus-producing locus should apparently be nearly always sub-terminal, with only a satellite of varying size and a thread of varying length

to complete the chromosome. In *Protozoa* (Chen, 1936) it appears that the nucleolus is produced as a body enclosing a considerable length of one chromosome which has no satellite or thread—a more primitive condition. In rice the condition could be interpreted as a terminal satellite without any thread.

Various cases are already known in which, in polyploids, the number of nucleoli is correspondingly increased. I have sketched elsewhere (Gates, 1937b) the development of this new knowledge. Three complementary lines of observation can now be brought to bear on the phylogeny of the nucleus in cases of primary or secondary polyploidy: (1) the maximum number of nucleoli in the telophase nuclei, as a preliminary indication of polyploidy; (2) the number of satellited chromosomes in somatic and meiotic mitoses, and any differences between their satellites as well as the number of bivalents attached to the nucleolus in zygotene to diakinesis; (3) the maximum secondary pairing of chromosomes in first and second metaphase. When these results confirm each other, the evidence of former changes, even in the basic number of chromosomes, is on a firm basis. It is becoming clear that such changes have instituted many new genera, new tribes, and even new families.

A striking case authenticated by these means is that of rice, in which Sakai (1935) and Nandi (1936) have independently concluded from such evidence that the genus *Oryza*, which has $n=12$ chromosomes, was derived through secondary polyploidy from an ancestral condition in which $n=5$. The secondary pairing was found by both authors to be three groups of two bivalents and two groups of three bivalents. That 5 is the basic number in *Oryzæ* is confirmed by Ramanujam (1938), who finds that *Zizania* has $2n=30$ and concludes from various other counts that the *Zizaniineæ* retained the number 5 as a basis for polyploidy, while the *Oryzineæ* were built up on a basis of 12. We may therefore conclude that the differentiation between these two groups began with the change from a basis of 5 to a secondary basic number of 12 chromosomes. In one group hexaploidy and in the other tetraploidy has been developed since.

Nandi (1936) found two bivalents attached to the nucleolus in P.M.C.'s of *Oryza sativa*, while four bivalents were attached in the tetraploid *O. minuta* ($2n=48$). Ramanujam (1937a) has shown that an autotriploid mutation of *O. sativa* has three nucleoli in its telophase nuclei, whereas the diploid of this variety has two. This particular variety appears, therefore, to have lost one of its nucleolus-producing satellites, for a variety with two bivalents attached to the nucleolus in the P.M.C. will have four in somatic telophases before they begin to fuse. Ramanujam has shown how the "inheritance" of the nucleolus in a hybrid strain between two varieties of rice, one having two and the other four nucleoli as seen in early telophases, can take place. In later generations some plants from such a cross will have two SAT-chromosomes, some three and some four. Hedayetullah (1933) studied a cross between two rice varieties which was evidently of this character. One parent had two large nucleoli, the other one large nucleolus in the

P.M.C.'s. The P.M.C.'s of the F_1 contained one large nucleolus (which would be produced by a pair of SAT-chromosomes) and one small nucleolus from the single SAT-chromosome.

It therefore seems clear that in secondary tetraploids such as rice one of the duplicated satellites can be lost, presumably through mutation, and that its crosses with the original form will give a homozygous segregate having a single pair of SAT-chromosomes. Presumably when such a mutation occurs in a simple diploid it is lethal, at least in the homozygous condition.

Bhatia (1938) has obtained equally significant results with the nucleoli of wheat. He shows that in the resting nuclei of the P.M.C. of the tetraploid *Triticum dicoccum* there are four nucleoli, two large and two small (suggesting that it is an allotetraploid), while in the zygotene and later stages two bivalents are attached to the single large fusion nucleolus in each nucleus. Similarly in the hexaploid *T. vulgare* six nucleoli fuse into one, six leptotene threads are attached to it, and later the three bivalents retain this attachment. Comparative studies of the nucleoli of *Aegilops* should furnish evidence as to whether this genus has played a part in the phylogeny of hexaploid wheats.

Satô (1936) has made similar studies of *Nerine curviflora* ($2n=22$), with two nucleoli in the telophase nuclei, and *N. humilis* ($2n=33$), apparently an autotriploid species with three nucleoli. *Gasteria obscura* ($2n=14$) is an apparent diploid with, nevertheless, four nucleoli, two large and two small. This condition requires further investigation. *G. maculata* ($2n=28$) is a tetraploid with eight satellites and eight nucleoli. In certain species of *Scilla* the same author finds a satellite translocated to the proximal end of another chromosome. The sporadic occurrence of such a translocation has been observed both in plants (*Allium*) and animals (*Amblystoma*). Resende (1937b) has recently described in species of *Aloe* several cases of translocations involving a satellite. In *A. Schlechteri* changes in the size of the satellite, as well as shortening of the connecting thread and loss or translocation of satellites, have all been observed. They apparently arose as mutations and some individual plants were heterozygous for such conditions.

It is not necessary to consider here the general relation between the nucleolus and the chromosomes. Suffice it to say that recent micro-chemical studies, such as that of Marshak (1931) and various others, establish an intimate resemblance between the substance of the nucleolus and the matrix of the chromosomes. It appears probable that under the influence of the nucleolar body the matrix material, as it is lost from the chromosome threads in telophase, is accumulated, probably after undergoing some transformation, to form the growing nucleolus. In the abnormal absence of this organizing body the matrix material from the various chromosomes simply accumulates in droplets in the nucleus.

The work of Painter (1934), Bridges (1935), Koltzoff (1934), Frolova (1936), Heitz (1934, 1935), and many others on salivary chromosomes of various insects offered great promise of a fuller understanding of chromosome

structure. Their enormous size, the identification of the bands or discs with genes, and their mapping in the chromosomes make possible an observational study of duplications, deletions, inversions, and other translocations, as well as their genetic effect. In this way such problems as the position effect,* the origin of many dominant mutations through duplications, and the difference between recessive gene mutations and minute deletions are being solved. Nevertheless, despite their enormous size, the analysis of the salivary chromosomes from a cytological point of view is still far from satisfactory. The original conceptions of Koltzoff and Bridges seemed to give a clear picture of the salivary chromosome as a structure in which the chromonemata had multiplied and the discs represented a row of chromomeres. But the subsequent observations and experiments, particularly of Metz (1937), etc.), throw doubt on these conclusions, for he suggests that the genonemes do not exist, but instead a honeycomb structure of chromatic and achromatic droplets. He also definitely adopted the chromonema as against the chromomere theory of ordinary animal chromosomes. Buck (1937) finds, in a study of the early development of the salivary glands of *Sciara*, that the homologous chromosomes are at first paired and have the appearance of slender "chromomeric" threads. Then they split, and sister strands become joined by cross-connections between some of the "homologous chromomeres." The four strands then synapse and twist about each other, the dividing line between chromatids disappearing. The cross-connections become heavier, foreshadowing the bands and obscuring the original "chromomeric structure." Hence the bands or discs appear to develop as structures distinct from the original chromomeres, but in a definite relation to them.

The time has not yet arrived to draw conclusions in the very promising field of protein chemistry regarding the relations between the spiral chromonemata and molecular protein chains. We need only remark that the elusive genic material which reproduces by duplication must lie either in the axis of the protein molecule or, perhaps more probably, in some unit of structure intermediate between the "globular" proteins and the visible chromonema. All that we really know, however, about the so-called genes is that they represent a *difference* arising in the germplasm through a mutation, as I first pointed out in 1915.

SUMMARY AND CONCLUSIONS.

A large mass of direct observation of the larger chromosomes forces the conclusion that somatic chromosomes in metaphase are composed of four strands twisted about each other in pairs, while anaphase and telophase chromosomes are composed of two intertwined strands.

The evidence from X-ray experiments is indirect and conflicting, each

* A clear case of a position effect in *Drosophila* has recently been found by Grüneberg (1937), who obtained a re-inversion of a long section of the X-chromosome, accompanied by reversion phenotypically from rough eye to normal. The genetical results were confirmed cytologically in the salivary chromosomes by Emmens (1937).

investigator interpreting his results in accordance with the views he previously held or else finding that the evidence is too indirect to yield any certain conclusions regarding chromosome structure.

The chromomere *vs.* the chromonema hypothesis needs further investigation. Various appearances have been interpreted as chromomeres when in reality chromonemata were involved. Whether visible chromomeres correspond with ultramicroscopic "genes" remains to be determined.

The importance of satellites and nucleoli as features of chromosome structure is emphasized. The following lines of observation are complementary in tracing the phylogeny of nuclear structure in connection with primary or secondary polyploidy: (1) the maximum number of nucleoli in early telophase nuclei; (2) the number of satellited chromosomes and the size of the satellites in somatic and meiotic mitoses; (3) the maximum secondary pairing of bivalents in first and second metaphase.

It appears that a pair of satellites can be lost through mutation in a primary or secondary polyploid, and that this process has happened in various genera. Translocations of a satellite can also occur, as well as changes in its size or in the length of the connecting thread. Some plants are heterozygous for such changes.

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V.—SOME METHODS OF PREPARING TELEOST FISH OTOLITHS FOR EXAMINATION.

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SIX TEXT-FIGURES.

WHILE studying fish otoliths, methods of examining the specimens have developed which may be of interest to others working on the same or similar subjects.

The processes to be described here are surface grinding, examination liquids, and making sections.

SURFACE GRINDING AND POLISHING.

Many even of the smaller and thinner otoliths require more or less grinding on the convex surface before all the zones can be seen from that side.

Materials.—The razor hone made from the Solenhofen lithographic slate has been found to give good results.

The stone must be used with water. It should have a flat surface and if it wears into hollows it is easy to grind it true on a flat metal or glass plate with emery or carborundum powder and water.

When the mud from grinding becomes thick it should be washed off. A flat piece of pumice stone rubbed lightly with water over the stone before use and washed off keeps the surface in good condition and seems to improve the "bite" of the stone. Coarse gritty stones may damage otoliths.

Polishing after grinding usually increases the visibility of structure. Jeweller's rouge used dry on paper or the finest grades of "French" emery paper, Nos. 0, 00, and 000 used in succession, produce a good polish.

The polishing materials must be kept free from grit.

Before changing from a coarser to a finer stone, or polish, the otolith and any embedding material or holder attached to it should be washed with a soft brush and soap and water. A camel-hair or sable brush cut to $\frac{1}{8}$ inch in length is useful. Drying may be done with a soft rag.

Otoliths which have to be ground on the convex surface are mounted on the rounded end of a piece of glass rod 2 or 3 inches in length in the following way.

Lay the otolith concave surface up. Heat the rounded end of the rod until a fragment of hard colophonium or balsam will stick to it, and continue heating until the resin is liquid; then press the end of the rod into the con-

cavity of the otolith. Shellac may be used instead of resin, but the transparency of the latter may allow of examination by transmitted light.

If the operation has been successful the otolith will be firmly adherent to the rod. The resin should be in contact with all parts of the otolith except the convex surface, but it should not extend much beyond the margin in case it comes in contact with the stone and clogs it during grinding.

An otolith mounted in the way described can be ground with greater safety and precision than if it were held in the fingers. Otoliths at the best are fragile, and their fragility may be greatly increased by the cracks which occur in most of them, however carefully they may have been treated. Commonly one or more cracks pass through, or close to, the centre of growth, i.e. the earliest formed part.

The stone is moistened with water, the glass rod is held in the hand, and the otolith is rubbed lightly on the stone or polisher, or the rod may be held upright—a hole in a wooden block is convenient—and the stone held in the hand and used like a file. Stones to be used thus should be light, e.g. emery



FIG. 1.—Plate with V-gap to prevent movement of object in cell.

paper glued on strips of wood and used dry or “slips” of medium or fine “India stone” used with water.

Most of the grinding required is, usually, nearer the centre of the otolith than the edge, but before finishing grinding the superficial roughnesses of all parts of the surface should be removed and the whole surface polished.

Grinding should be done with caution. It is very easy to grind off too much. The surface being ground should be frequently cleaned and examined under the microscope to control progress.

When the surface is finished, if the otolith seems fairly strong and is not badly cracked, the glass rod may be heated until the resin melts and the otolith pushed off and placed in alcohol to dissolve any resin on it, but if it seems very fragile it is better to place it in alcohol while still on the glass rod until it falls off.

The concave surface should always be examined by transmitted and reflected light both when dry and when in one of the liquids to be mentioned later. Sometimes the zones are much better seen from the concave surface than from the convex even when the latter is ground.

When an otolith under examination in a cell shows a tendency to shift its position it can be kept in place by a metal plate made to fit the cell. A V- or other space cut out of the plate on one side accommodates the otolith and keeps it steady. The plate may be made of lead, as that metal is easily shaped. A celluloid plate may be used with chloral hydrate solution, but not with anilin, in which celluloid is soluble.

EXAMINATION AND MOUNTING MEDIA.

The examination of otoliths, especially through the surfaces, is aided by the use of certain media of high refractive index. The late Professor Hornyold's remark (*J.R.M.S.*, 1922, p. 16) that otoliths became more transparent in creosote (R.I. 1.538) than in xylol (R.I. 1.497) led to experiments with liquids of higher R.I. than creosote. It was found, when anilin (R.I. 1.580) was used, that zones and other structures invisible in creosote often became visible, and that the whole picture was more clearly seen. Anilin has several drawbacks. When freshly prepared it is said to be colourless or to have a faint amber colour, but it darkens rapidly and the dark red-brown colour sometimes obscures the view of parts of the object which are deeply immersed. More than enough to fill the cell must be used or bubbles of air will be drawn under the cover-glass as it is put on, and this excess must be removed after the cover is in place. A small sable brush is the best tool for removing the excess.

Anilin evaporates rapidly and when it is desired to keep a preparation for more than ten or twelve hours, e.g. for completing a drawing, a little more must be added cautiously at the edge of the cover-glass with the brush at the end and beginning of each day. The visibility of structure tends to improve after a day or two in anilin and specimens have remained in it without apparent harm for weeks.

No satisfactory method of sealing the cover-glass has yet been found. Anilin seems to creep through all the cements tried.

An otolith which has been removed from anilin and dried without washing, examined dry and uncovered, shows the general outlines of the groove (when one is present) and any other surface irregularities much better than when clean. A light wash of sepia water colour acts in much the same way.

A strong solution of chloral hydrate in water (R.I. unknown) or aniseed oil (R.I. 1.557) give nearly as much detail as anilin. The colour difficulty does not arise with either and they are easier to use. Cinnamon oil (R.I. 1.619) is not so good as the other liquids mentioned.

It is possible that a medium of higher R.I. than Canada balsam (R.I. when solid 1.535) or colophonium (R.I. 1.545) may be better for permanent mounts. Styra^x (R.I. 1.63) and a mixture of one part each of solid styra^x and colophonium dissolved in xylol have both been tried. The former is not so good as colophonium, but the latter seems to be better.

Both surfaces and sections have been fairly well seen when freshly mounted in glycerine jelly, but it is not safe for permanent mounts. After a time the dark zones seem to become cloudy and badly defined.

SECTION MAKING.

Sections are made by grinding away about half of an otolith and then most of the remainder. Although making a section destroys the greater part of

the specimen, yet at any point the process may be stopped while a sketch or other record of the surface exposed at the moment is made.

Sections are the only means by which the internal structure of some otoliths can be seen, and they are of interest in other cases, e.g. where one of a pair is studied through the surface and the other as a section.

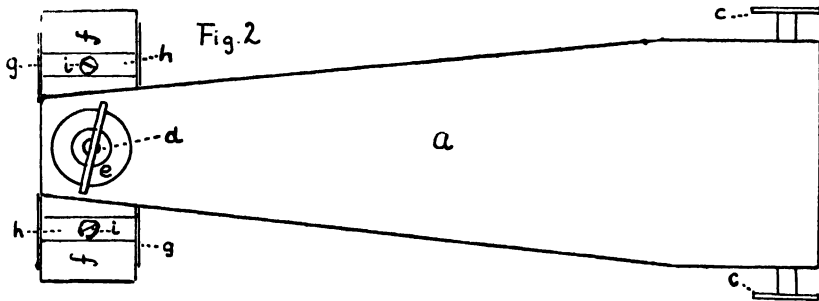


FIG. 2.—The grinder from above.

a, back plate ; *c*, wheels ; *d*, bolt and nut ; *e*, washers ; *f*, carrier ; *g*, clips ; *h*, clip bars ; *i*, clip screws.

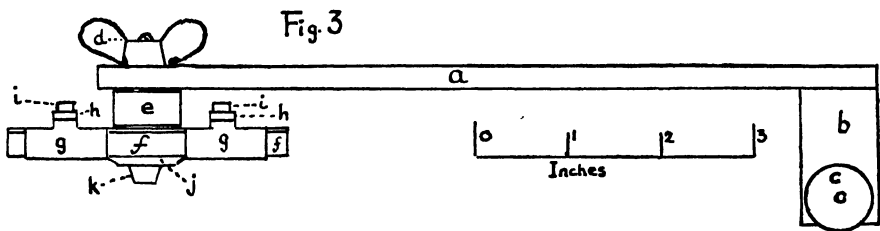


FIG. 3.—Side view of grinder.

b, block carrying wheels; *j*, embedding plate held by clips; *k*, otolith in shellac on embedding plate; other letters as in fig. 2.

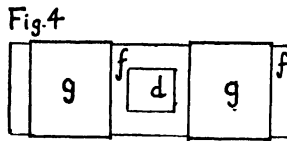


FIG. 4.—Carrier and clips from underside.

d, square head of bolt sunk in surface of carrier. Other letters as in fig. 2. Scale of inches.

A simple apparatus, which for brevity may be called the grinder, figs. 2, 3, and 4, is used for making sections. When in use the grinder rests on three points, one of which is the object to be ground. It can therefore be made to produce sections with flat parallel surfaces.

It consists of a light deal board *a* shaped as shown in figs. 2 and 3.. To the underside of the broader end a block of wood *b* is screwed, and at each end of *b* a small wheel *c* is fixed so that it can revolve freely.

A bolt *d* with a fly-nut attaches *a* to the carrier *f*, a wooden plate with a metal back. The bolt has a square head, fig. 4, which is sunk in the under-surface of the carrier so that it lies flush. On the bolt between the under-side of *a* and the carrier are a tin washer, a wooden one $\frac{3}{8}$ inch thick, and another tin one, in the order given. Between the fly-nut of *d* and the upper surface of *a* is another tin washer. All the washers are marked *e* in figs. 2 and 3.

Sliding easily, but without shake, on the under-surface and sides of the carrier, but not continued over its upper surface, are two thin metal bands, the clips *g*, figs. 2, 3, and 4. The sides of each clip are joined across the upper surface of the carrier by a metal bar, *h*, figs. 2 and 3, through which passes a screw *i* the point of which, when in use, presses on the metal back of the carrier drawing the clip tightly against the lower surface so that any thin object between the carrier and the clip would be held firmly.

The embedding plate *j*, figs. 3, 5, and 6, is a piece of sheet glass of any convenient size bevelled at each end.

When about to be used the embedding plate is attached to the carrier in

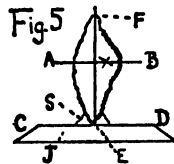


Fig. 5.—Diagram of an otolith fixed on an embedding plate to produce a transverse section. \times Centre of growth; A-B, plane of "face" of section parallel to C-D (upper surface of plate); E-F, extremities of long axis of otolith; S, shellac holding otolith in position for embedding; J, plate.

the following way—the plate is laid on the centre of the carrier, its larger surface in contact with the square head of the bolt *d*, fig. 4, and its bevelled ends facing the clips. One clip is pushed against the plate so that its edge covers about one third of the bevel. The clip screw *i* is then screwed down so that the clip cannot move. The second clip is then forced over the edge of the bevel at the other end of the plate and when its screw is tightened the plate is firmly held. When it is desired to remove the plate it is, of course, sufficient to slacken one of the screws and move the clip.

Glass is chosen for the embedding plate so that the section, when nearly finished and still attached to it, can be examined by transmitted light. The plate is easily made by grinding a bevel at each end of a piece of sheet glass. A carborundum stone is suitable for the purpose and the glass can be held in the hand, or the grinder could very easily be adapted for the purpose.

The dimensions and arrangement of the grinder given in figs. 2-4 are only those of a particular model, and they may be varied. The first model of the machine consisted of a block of wood $2 \times 1 \times \frac{1}{2}$ inch with wheels which ran on the stone and a rough holder for the object, but it ground flat surfaces of any size within its capacity and made good sections.

Before making a section of an otolith it should, if possible, be examined through both surfaces and the position for the section chosen. If the position of the centre of growth cannot be seen from either surface it can only be found by grinding away the otolith by degrees and looking for it in the series of surfaces exposed. Assuming that the centre is visible, a section through it cutting the long axis of the otolith at right angles is useful and may be taken as an example, see fig. 5. It is helpful in later operations to determine at this point (1) which surface of the section is to be the "face," i.e. next the cover glass when finished; and (2) the distance from the "face" to the farthest point of the otolith on the same side—that is, the distance from the line A-B to the point F on the line E-F in fig. 5.

It may be noted here that the point F is the first part of the otolith to be exposed when grinding commences.

In some species the groove in the convex surface is so deep in proportion to the thickness of the otolith that the section is very likely to break at that point before it is finished.

In such cases the otolith may be strengthened before embedding or re-embedding by applying several coats of a solution of shellac in alcohol to the groove. Each coat must be dry before the next is given. The solution fills up the groove in a way that the melted shellac used for embedding may fail to do.

The stone and polishes mentioned before are equally good for sections. The otolith is embedded in the following way. A fragment of shellac is melted on the embedding plate and, while it is fluid, the otolith is placed in it in such a position that the plane of the section desired is parallel to the surface of the plate, and this position is maintained until the shellac solidifies. More shellac is melted and dropped, at first, so as to fall on the plate and lower end of the otolith, and afterwards on the otolith and shellac already deposited, until a mass of shellac adhering to the plate is built up round the otolith, covering it completely and in close contact with it at all points. If contact is not complete anywhere the shellac at that point must be softened by heat—a small soldering iron or a gas flame $\frac{1}{8}$ inch in length are both handy for the purpose—and the shellac, while plastic, is pressed into contact with the otolith. Shellac is used for embedding because it is strong, grinds cleanly, and is not sticky. The heat of the melted shellac does not seem to damage otoliths.

When the process of embedding is finished the plate is fixed to the carrier by the clips in the way already described. The fly-nut of bolt *d* is then screwed down so that the carrier is fixed in any position preferred relative to the grinder. Commonly grinding proceeds more smoothly in one position of the carrier than another.

The stone is moistened with water and the grinder is placed so that the block of shellac containing the otolith rests on the stone and the wheels on the table.

Throughout the grinding of a section it is preferred to keep the back of the

grinder approximately horizontal. Adjustment is made by placing pieces of thin wooden board or cardboard under the stone or the wheels as may be necessary.

The hand is laid on the back of the grinder and the machine is pushed to and fro so that the shellac mass on the embedding plate rubs on the stone. After even one or two strokes the apex of the mass begins to flatten, and the flat surface increases in extent with every stroke.

The ground surface should be looked at frequently to watch for the first appearance of the otolith, and as soon as it is seen as a glistening white point the embedding plate is removed from the grinder and the distance between the lower surface of the plate and the ground surface is measured with a micrometer gauge. This measurement, less the thickness of the plate, is the distance E-F in fig. 5, and with the measurement previously made under the microscope of the distance from F to the "face" of the section A-B in fig. 5, the operator now knows, approximately, how much of the otolith has to be ground off before the "face" is reached.

By repeating this measurement occasionally and counting the number of strokes on the stone between consecutive measurements, some idea of the

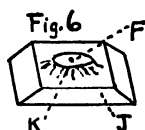


FIG. 6.—Otolith in shellac on plate sufficiently ground to show point of otolith F corresponding to F in fig. 5.

rate of grinding, i.e. the amount removed per stroke, can be formed. Knowledge of the rate becomes important when it is desired to remove very small amounts, e.g. when the "face" of the section is nearly reached.

The rate with any given stone depends on the pressure on the back of the grinder and the area of the shellac surface.

As the embedding mass is more or less conical the area of the ground surface becomes larger than is necessary to support the otolith and it may be reduced by paring the edge of the mass. It is well to wash away the chips after doing so.

From this time until the section is finished it will be necessary from time to time to wash the embedding plate, shellac, and otolith. While the otolith is supported by the shellac it may be dried with a soft rag, but when the shellac is removed drying is better done in hot air.

Occasionally the ground surface of the otolith should be examined under the microscope. A drop of cedar-wood oil on a cover-glass may be laid on the surface or, for a rough inspection, a film of cedar-wood oil without a cover is sufficient. Anilin and chloral hydrate solution have a solvent action on shellac and cannot be used during grinding.

Inspection should be more frequent when the plane of the section is

neared, as the appearance of the section helps to decide the point at which to stop grinding. When it is judged that grinding should cease the plate is removed from the grinder and it and the embedding mass are washed.

The plate is replaced and the polishing done. As a rule polishing removes very little substance, but it varies and the process should be watched in case it removes too much.

The plate is washed again and the "face" of the section is finished.

The otolith must now be detached from the plate, either by heat or, more safely, by paring away superfluous shellac and placing the plate in alcohol until the remaining shellac is dissolved. The action of the alcohol may be hastened by heat. When the remaining half of the otolith is separated from the plate it is re-embedded in shellac with the finished "face" resting on the embedding plate.

The otolith is now measured, ground, and examined as before. Grinding usually ceases when the section is about 0.0125 inch thick. Thinner sections can, of course, be made, but nothing seems to be gained; indeed, there may be loss, for general purposes, by making thinner ones, as the markings become very faint.

When the grinding is done the "back" of the section, now uppermost, must be polished and washed and the section is finished. The section is removed from the plate by alcohol, but it is safer, before doing so, to stick a small strip of toilet paper about the width of the section and a trifle longer to the exposed "back" of the section.

A watery solution of gelatin is used and the paper must be wet on both sides, but not flooded, with the solution. The plate with the section should now be placed in a hot-air oven until they are quite dry before going into alcohol. The plate and section having separated in alcohol, the section is lifted by the end of the paper and washed in changes of alcohol. A good deal of dirt from the shellac and stone may be found about the section and it may, if necessary, be gently cleaned with a small soft brush while in alcohol. The section is dried in hot air and when it is dry a small drop of resinous mounting medium is placed on a cover-glass and the "face" of the section is pressed gently into the drop. The cover-glass and section are dried until the resin is quite hard. They are then placed in water until the paper and gelatin can be washed off and when dried again the section may be mounted.

SUMMARY.

The following processes are described.

- (1) Grinding the surface of an otolith.
- (2) The use of liquids of high refractive index for examination.
- (3) The construction and use of a hand grinding machine for producing sections.

VI.—ROOT-TIP SMEAR TECHNIQUE AND THE DIFFERENTIAL STAINING OF THE NUCLEOLUS.

By P. N. BHADURI.

(Read May 18th, 1938.)

ONE PLATE.

THE possibility of applying the smear technique to root-tips as a satisfactory method for cytological observations has only recently been fully appreciated. Formerly the smear method was merely applicable to material fixed in acetic alcohol and subsequently stained in aceto-carmin. This procedure, though found to be satisfactory by quite a number of investigators, Heitz,⁴ Warmke,¹¹ and Brown,² has been superseded by the "Nukleal-Quetschmethode" described by Heitz.⁵ The importance of the latter technique as a time-saving method, especially when a large number of plants has to be examined, was emphasized by Heitz himself and can be at once realized from the work of Resende.⁸ The advantage of the latter technique over the former lies in the fact that one can use a better fixative here, while the Feulgen staining is much superior and more selective than aceto-carmin.

One of the greatest drawbacks to the use of Feulgen staining for critical cytological observations has been that any counter-staining was found to be unworkable. According to Heitz,⁵ however, the brownish-yellow colour of the nucleolus found after the use of chrom-osmium fixation proved to be quite satisfactory for the study of the nucleolus during mitosis. The Heitz method, besides being unsatisfactory for certain cytological observations, has the additional disadvantage that the chrom-osmium fixation makes subsequent staining rather difficult. This matter will be further discussed later on. The recent discovery of a method of differential staining for the nucleolus by Semmens and Bhaduri¹⁰ has not only overcome this difficulty but has also rendered certain cytological observations much more certain and conclusive than was the case with any previous techniques. As the above account of the differential staining of the nucleolus is designed for microtome sections, a detailed account of the methods for making permanent root-tip smear preparations using the "new method of differential staining of the nucleolus" is put forward in the present paper. The importance of this method for critical cytological observations and the saving in time and labour will be realized at once by everybody interested in this branch of work.

Before going into the details of the methods it is necessary to emphasize here that success in bringing out a satisfactory preparation depends considerably on the mixture used for fixing the root-tip. Heitz⁴ and Resende⁸ used entirely chrom-osmium fixatives without acetic acid. Klingsteadt⁵ while working with certain insects found Navashin's fixing mixture to be most satisfactory. He also used 1 p.c. chromic acid as a subsequent treatment for material fixed in acetic alcohol. To ascertain the part played by the fixative in relation to the nucleolar staining, quite a number of fixatives were tried on the following plants: *Scilla nutans*, *S. sibirica*, *Crocus sativus*, *Triticum vulgare*, *Vicia Faba*, and *Solanum tuberosum*. The results obtained are given in Table I.

TABLE I

Fixative employed.	Feulgen staining.	Counter-staining of the nucleolus.
N/HCl at 60° C.	Satisfactory.	Failed.
Acetic alcohol 1 : 3	"	"
Formol-alcohol	"	"
Formalin 10 p.c.	"	"
Levitsky's chromic formalin 1 : 1	"	Brilliant, except for <i>Solanum</i> .
Chrom-acetic 1 p.c. chromic acid	"	Quite satisfactory for <i>Vicia</i> and
25 c.c., acetic acid glacial 2 c.c.	"	<i>Triticum</i> , but failed in <i>Scilla</i> .
Navashin's fixative	"	Quite satisfactory for <i>Vicia</i> , <i>Triticum</i> , <i>Crocus</i> , but poor for <i>Scilla</i> .
Benda, with low or without acetic acid.	Not quite satisfactory.	Satisfactory.
Levitsky's ' Platinic-formalin, weak	"	"

From the table it will be noticed that Levitsky's chromic-formalin gave the best result. It was found, however, in this case that the satellitic attachment to the nucleolus is not so clearly demonstrable as with material fixed in a mixture containing acetic acid. Navashin's fluid was found to be quite satisfactory for this purpose. It seems that the action of acetic acid brings about a contraction of the nucleolar substance and consequently draws out from the rest those chromosomes which are attached. These chromosomes are easily distinguishable from the rest, especially at the "haloed" area surrounding the nucleolus, which appears after such fixation. The normal composition of Navashin's fluid was found to be quite satisfactory in all the plants investigated except in *Scilla*. In the latter case the percentage of acetic acid was curtailed to a minimum, the percentage of formalin being slightly increased. It seems, therefore, advisable to find out by experiment the percentages of acetic acid and formalin most suitable for a particular plant.

In all the plants studied it was found, with the exception of *Solanum tuberosum*, that the Feulgen staining was quite satisfactory for material fixed in acetic alcohol (1 : 3). The nucleolar staining, however, was impossible in every case. It was further found that subsequent overnight treatment in

1 p.c. chromic acid or 2 p.c. potassium dichromate solution prepares the nucleolus sufficiently for a proper differential staining only in the case of *Vicia Faba*, *Crocus sativus*, and *Triticum vulgare*, but failed always in the case of *Scilla*. Overnight treatment in a mixture of 1 p.c. chromic and 10 p.c. formalin (1 : 1) improved the staining remarkably in the case of *Scilla* species. Addition of chromic crystals in acetic alcohol or methylated spirit did not work as theoretically expected and also pointed out by Waterman.¹² It was also found that preparations made from material fixed in acetic alcohol according to the method described later always showed a haziness over the entire tissue, probably due to the presence of some fine precipitate left after such fixation. In *Scilla*, however, no such difficulty was encountered.

For materials fixed in any mixture containing osmium or platinum it was found that, though the staining of the nucleolus was quite satisfactory, there always remained a general haze over the entire preparation, making critical observations extremely difficult. The staining of the chromosome or chromatin was also not so bright as that found in other cases. Bleaching the material overnight in alcoholic solution of H_2O_2 did not improve the situation. In *Scilla*, however, clear preparations were made by curtailing the period of fixation to 1-2 hours, but the nucleolus could not be stained differentially in this case.

The period of hydrolysis was also found to be a critical factor in making a successful preparation. Not only is optimum hydrolysis necessary for a bright Feulgen staining but a proper disintegration of the middle lamella is essential for a uniform smearing of the root-tip tissue. Bauer¹ has given a list showing the time necessary for the hydrolysis of microtome sections for each fixative he employed. From the present observations it was found that this period not only varies with the individual fixative but also varies considerably from plant to plant or from one tissue to the other of the same plant. For delicate roots with low chromatin content, e.g. *Solanum tuberosum*, the period of hydrolysis should be curtailed to a minimum, while for massive roots, like the primary root of *Vicia Faba*, the time can be prolonged even up to an hour. The optimum time of hydrolysis necessary for a particular plant under investigation should be found out at the beginning by experiments. Table II shows the time of hydrolysis found during the present study for material fixed in different fixatives.

Procedure for the smear technique : Material is fixed overnight in Nava-shin's fluid (the percentage of acetic acid and formalin suitable for the plant under investigation being previously determined by experiments) or in acetic alcohol 1 : 3. Material fixed in any of the fixatives can be stored in 80 p.c. alcohol with a drop or two of acetic acid. Root-tips fixed in acetic alcohol only were treated overnight before hydrolysis either in 1 p.c. chromic acid or in a mixture containing equal parts of 1 p.c. chromic acid and 10 p.c. formalin as found necessary for the particular plant under investigation.

Method I. Fixed root-tips after being properly washed were transferred



FIG. 1 (a).



FIG. 1 (b).

a and b. Prophase stage from a root-tip cell of *Scilla nutans*, showing the attachment of the satellite chromosome to the nucleolus (N), connecting the head (H) and the arm of the chromosome. Note the filament (F), which has taken the Feulgen stain, across the nucleolus. (Both the photographs have been taken from the same nucleus but at different foci and using different filters.)

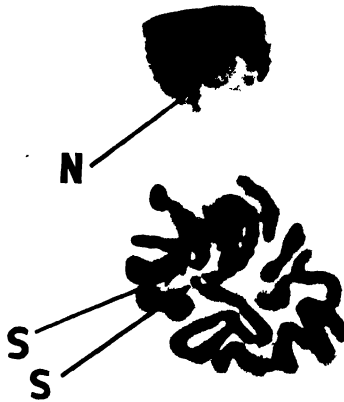


FIG. 2.

Somatic metaphase plate, polar view, from *Scilla nutans*. Note one pair of satellited chromosome (S). A resting nucleus is seen above; note the intensity of light green staining of the nucleolus (N).

to stoppered tubes containing N/HCl. These tubes were then placed in a beaker containing water and kept at 58°–60° C. in an oven. After a definite period of hydrolysis the material was washed with distilled water. It was then kept in decolorized fuchsin solution from $\frac{1}{2}$ hour to overnight, as found to be convenient. The fuchsin solution was prepared according to Tomasi,³ the dye being made from pararosanilin as supplied by G. T. Gurr, New King's Road, London S.W.6, following the method of Scanlan and Melin's⁹ sample 13. If stored in a well-corked bottle and kept in a dark place the decolorized fuchsin will keep easily for three weeks.

TABLE II

Name of the plant.	Fixatives used and the Period of Hydrolysis.			
	Acetic Alcohol.		Navashin's.	Benda with or without Acetic Acid.
<i>Scilla nutans</i>	10–15 minutes		20 minutes	25–30 minutes
<i>S. sibirica</i>	" "		20–25 "	" "
<i>Crocus sativus</i>	" "		30–35 "	" "
<i>Triticum vulgare</i>	20–25 "		45–60 "	30–35 "
<i>Vicia Faba</i>	5–7 "		10–15 "	10–15 "
<i>Solanum tuberosum</i>				

Each root-tip or portion of it, according to the size of the root-tip, was put on a clean slide with a drop of 45 p.c. acetic acid and covered with a cover-glass. By slight and uniform pressure on the cover-glass with a scalpel the tissue was smeared uniformly. After 2–5 minutes it is put horizontally in a tray containing a mixture of acetic acid and alcohol in equal proportions. Here the cover-glass separates from the slide and the tissue generally remains stuck either on the slide or on the cover-glass. The subsequent treatment is as follows :

The preparation is transferred to acetic-alcohol (1 : 9) and kept here for 5 minutes. It was then transferred to 95 p.c. alcohol, left here for 10 minutes, given two changes, then passed on to saturated solution of Na_2CO_3 in 80 p.c. alcohol and left in this for an hour. After rinsing thoroughly in 70 p.c. alcohol the preparation is left in 70 p.c. alcohol for 10 minutes. It is then transferred to light green stain, made according to Semmens and Bhaduri,¹⁰ and stained for 15 minutes. The smear was then differentiated under the microscope in a mixture containing 40 c.c. of 80 p.c. alcohol and 10 c.c. of saturated solution of Na_2CO_3 in 80 p.c. alcohol. It was then rinsed thoroughly in 70 p.c. alcohol and dehydrated in 95 and 100 p.c. alcohol. The preparation is first cleared in xylol alcohol and then in pure xylol. It is afterwards mounted in neutral balsam.

Method 2. Material stored in 80 p.c. alcohol was transferred to a solution containing equal parts of 95 p.c. alcohol and concentrated hydrochloric acid, as

used by Warmke¹² for aceto-carmin preparations. The advantage of this procedure is that this not only renders the tissue suitable for smearing but also performs the process of hydrolysis necessary for Feulgen staining without injuring or distorting the image of the cell or its content for cytological observations. The period of hydrolysis was also found to vary with the material, from 10–30 minutes, according to the nature and structure of the root. The material was brought to water gradually and then transferred to decolorized fuchsin solution. The subsequent procedure being the same as given in Method I.

In conclusion I desire to express my thanks to Prof. R. R. Gates, F.R.S., for helpful suggestions and kindly going through the manuscript. My thanks are also due to Mr. C. S. Semmens for help and for kindly taking the photomicrographs.

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EXPLANATION OF PHOTOMICROGRAPHS.

The photographs have been taken from smear preparations. Fixation—Modified Navashin's fluid. Hydrolysis—20 minutes. Feulgen staining— $\frac{1}{4}$ hour.

VII.—*PSEUDOAMPHIPRORA FUGEI* SPEC. NOV. A NEW
DIATOM FROM CANNED FISH

By N. INGRAM HENDEY, F.L.S., F.R.M.S.

(Read May 18th, 1938.)

THREE TEXT-FIGURES.

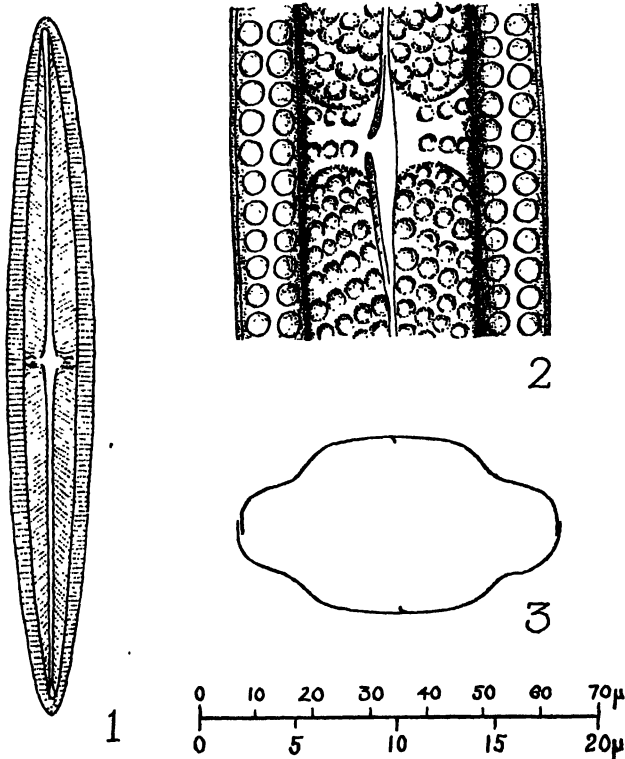
THE diatom to be described was observed in material obtained from Chinese canned fish, the exact source of which is unknown. Fuge (1937) was the first to examine this material and enumerated eleven species. Amongst these was the interesting and infrequent form *Nitzschia Firthii*, so remarkable for the fineness of its striations as to be the most severe test for 2 mm. objectives. The present species was discovered by Mr. Fuge after an exhaustive examination of the original material.

Pseudoamphiprora Fugei spec. nov. : *Valvis* lanceolatis, polis rotundatis, nodulis terminalibus parvis; *striis* medio radiantibus, margine transversis parallelisque; stauro conspicuo, punctis utraque margine in lineis duabus brevibus.

Dimensions of holotype, $123\ \mu \times 15\ \mu$, striations 6 to 8 in $10\ \mu$. Holotype, in herb. Royal Microscopical Society.

As certain taxonomic difficulties were encountered in identifying this organism, the following notes may be of interest. The genus *Pseudoamphiprora* was created by Cleve in 1894, in the "Synopsis of the Naviculoid Diatoms," p. 70. Prior to this, Cleve (1881, p. 13) proposed to use the name "*Pseudoamphiprora*" as a section of *Navicula*, to include several forms which were in some respects akin to *Amphiprora* and to *Stauroneis*. Cleve stated that "The valve on both sides in the median line is divided by a keel into two portions. The central nodule is transversely dilated into a short stauros, reaching the above-named keels. The type of the section is *Navicula arctica* Cl. in my paper on the Arctic Diatoms (*Bih. till K. Sv. Vet-Ak. Handl.*, 1873, 1, No. 13, p. 16, pl. 3, fig. 13)." Cleve stated that *Navicula arctica* Cleve 1873 was synonymous with *Amphora stauroptera* Bailey (*Smiths. Contr.*, 7, 8, figs. 14, 15, 1853) [1854], and that it was later illustrated by Gregory in the "Diatoms of the Clyde," 1857, p. 34, pl. 4, fig. 59c [1857 p. 505, pl. 12, fig. 59c] under the name *Amphiprora lepidoptera* Gregory. When the genus *Pseudoamphiprora* was established in 1894, Cleve made the correct combination *Pseudoamphiprora stauroptera* (Bail.) based on *Amphora stauroptera* Bail., which was synonymous with *Amphiprora lepidoptera* Greg. p.p., 1857, p. 505, pl. 12, fig. 59c. It is clear that by 1894 ("Synopsis

of the Naviculoid Diatoms") Cleve had thoroughly examined and understood the structure of *Pseudoamphiprora stauroptera*, and realized that contrary to his original idea of the species, the keels he described in 1873 when he used *Pseudoamphiprora* as a section of *Navicula*, were absent. It is probable that Cleve was influenced by Gregory, who, on plate 12 of his "Diatoms of the Clyde" produced three figures (figs. 59, 59b, 59c), under the name *Amphiprora lepidoptera*, giving the impression that the three illustrations were of one species, and that it possessed the characteristic structure



FIGS. 1—3.

of *Amphiprora*, that is, that the valves were furnished with alate keels. Cleve determined, however, that this was erroneous and that Gregory's figures illustrated two entirely different species. Figs. 59 and 59b are of one species, whose valves are furnished with short but unmistakable keels. This species has now been transferred to *Tropidoneis* (Cleve 1894, p. 25). Fig. 59c was of different structure and did not possess the alate keel, and it was this species that Cleve considered synonymous with *Amphora stauroptera* (Bailey 1854, p. 8, figs. 14, 15), and which he intended to be the type of *Pseudoamphiprora*. Under the generic description of *Pseudoamphiprora* 1894 no mention of the keel is made, but the diagnostic characters appear as :

“ Valve more or less lanceolate and convex. Median line straight. Central nodule transversely dilated into a stauros, not reaching the margin, but abutting on two longitudinal lines, one on each side of the median line. Axial area indistinct, central area a transverse fascia. Striæ nearly parallel, composed of fine puncta. Connecting zone not complex.”

The diatom observed in the canned fish material portrays these characters clearly, but differs from the previously described species in that the striations of the central area, that is, the area enclosed by the two longitudinal lines, are strongly radial, and the striations of the outer or marginal areas are transverse, and that the stauros is interrupted by one or two short lines of puncta, upon either side of the raphe, whereas in the previously described species the striations of both areas are in the same direction, or nearly so, or those of the enclosed or central area are radial about the polar nodules, so as to appear divergent at the central stauros, which is devoid of puncta.

Cleve (1894) was aware that this small group of species was interesting and provided taxonomic difficulties, and suggested that its systematic position should be between *Navicula Lyratae* and *Caloneis*. It is well to consider it also in relation to the genus *Scoresbya* Henvey 1937. In *Scoresbya* a similar structure obtains. The valve is divided by longitudinal lines and a large stauros at the central area extends to these lines. The central or enclosed area of the valve is transversely striate, while the outer or marginal areas appear as hyaline spaces devoid of structure. The stauros appearing as a bridge connecting the two marginal areas. *Pseudoamphiprora* appears to possess stronger naviculoid tendencies than *Scoresbya* and its position should immediately precede *Scoresbya* in the systematic classification (Henvey 1937, p. 205).

The interpretation of optical images seen in a microscope is always a matter of difficulty, particularly so when dealing with diatoms, and it must be remembered always that when lines or markings upon a diatom are spoken of, they are not lines or markings in the ordinary sense of the word, not in the sense, for instance, of a black line or mark upon a white background, such as an ink line upon a piece of paper, but rather that they are areas of greater or less density or thickness, arranged in some periodic order. The opalescent silica or matrix of the diatom valve, of uniform thickness, transmits light uniformly at right-angles to all its surfaces, and the appearance of lines or markings upon such a surface is due usually to folds or curving surfaces presenting an end-on view of the silica wall. Such are the longitudinal lines mentioned in the description of *Pseudoamphiprora*. These lines are formed by the curvature of valve. The raphe and the central area of the valve are raised considerably above the level of the marginal areas, and it is the curving down of the valve-substance to the lower level that presents an end-on view of the cell wall that gives the impression of a line between the raphe and the margin of the valve. Text-fig. 3 gives a diagrammatic representation of the probable appearance of a transapical section on the principle axis of the cell.

DESCRIPTION OF TEXT-FIGURES.

FIG. 1.—*Pseudoamphiprora Fugei* Hendey. Cell in valve-view.

FIG. 2.—Central area of cell, showing stauros.

FIG. 3.—Diagrammatic representation of probable appearance of a transapical section.

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ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

Rapid Staining of Blood Smears.—L. H. GOLDBERG ("A Rapid Method for Staining Blood Smears," *J. lab. clin. Med.*, 1938, **23**, 959). The blood film is rested on the edge of a tumbler three-quarters full of distilled water, covered entirely with Wright's solution, and left on for about 10 seconds: the stain is ignited and allowed to burn for from 10 to 20 seconds. The flaming slide is then tipped into the distilled water, removed, and dried. A thin to medium streaked blood smear is most suitable for use with this technique. G. M. F.

Rapid Staining of Spirochætes.—H. D. BAILEY ("A Practical Stain for the Spirochætes of Syphilis and Vincent's Angina," *J. lab. clin. Med.*, 1938, **23**, 960). Smears are made on a clean slide, dried in air, fixed with heat, covered with N/20 HCl for 10 seconds, washed in running water for 5 seconds, covered with Gram's iodine for 5–10 seconds, washed, covered with aniline-gentian violet for 5–10 seconds, washed, covered with Grams' iodine for 5–10 seconds, washed, covered with aniline-gentian violet for 5–10 seconds, washed, and blotted. The stain is not permanent. G. M. F.

New Methods for Staining Myelin Sheaths.—S. LA MANNA ("Die Markscheidenfärbung," *Z. Wiss. Mikr.*, 1937, **54**, 257–87). Two methods are described, the first for frozen sections, the second for paraffin-embedded material. For frozen material tissues are fixed either in 10 p.c. formalin for 4 or 5 days, in 40 p.c. formalin for 2 or 3 days at room temperature, or at 56° C. for 1 day in 5 p.c. ZnCl₂, Cd(NO₃)₂, CdCl₂, or CuCl₂ in 100 c.c. of saturated potassium bichromate. If fixed in formalin, tissues are washed in tap-water for 30 minutes or after the bichromate solution for several hours. Tissues are embedded in gelatine, hardened for 1 day in 10 p.c. formalin, rinsed, and cut. After sectioning, tissues are placed for 10 minutes in 5 p.c. NaOH, washed for 5 minutes, and fixed to the slide by gelatin fixative. Sections are mordanted for 10 minutes in FeCl₃ solution, washed for 5 minutes in 5 p.c. of the same solution, stained for 10 minutes in 1 p.c. hæmatoxylin with 1 drop of the 5 p.c. ferric chloride solution in 3 c.c. of the hæmatoxylin. Sections are rinsed for a few minutes in tap-water, differentiated in 5 p.c. mordant, rinsed, dehydrated, cleared, and mounted.

For paraffin material fix for 3 days in 10 p.c. formalin: mordant for 24 hours at 56° C. in bichromate solution. Wash for 6 hours in tap-water, dehydrate in ascending alcohols, xylol, soft paraffin for 3 hours, and hard paraffin with 5–10 p.c. beeswax for 4 hours. After sectioning and passing down to water sections are mordanted in the iron perchloride solution for 1 hour, rinsed for 5–10 seconds

in a 5 p.c. dilution of the same mordant, stained for 1 hour in 1 p.c. hæmatoxylin, rinsed for several hours in tap-water, differentiated in 5 p.c. FeCl_3 solution, washed for 1 hour in tap-water, dehydrated, cleared, and mounted. G. M. F.

Examination of Nervous Tissues by Terry's Method for the Rapid diagnosis of Swine Fever.—F. M. DA ROSA ((i) "Application de la méthode de Benjamin-Terry à l'examen histologique des centres nerveux. Diagnostic rapide de la peste porcine." (ii) "Technique rapide d'inclusion pour le diagnostic neuro-pathologique de la peste porcine," *Repos. Lab. Pat. vet., Lisboa*, 1936, 3, 92-5, 2 pls., and *ibid.*, 1936, 3, 96-7, 4 pls.). A rapid paraffin-embedding method is described which takes 1 day. The brain tissue is fixed either for 24 hours in 10 p.c. formol saline or by heating the tissue in 20 p.c. formol saline nearly to boiling-point for 3 minutes. Thin slices of the tissues are cut, stained superficially on one side with polychrome methylene blue, mounted under a cover-glass with the stained side up, and examined by transmitting light through the unstained tissue. G. M. F.

A Method for the Histological Detection of Glycogen.—H. GENDRE ("A propos des procédés de fixation et de détection histologique du glycogène," *Bull. Histol. appl.*, 1937, 14, 262-64). Tissues are fixed in the following modified Bouin-solution: saturated picric acid solution in 90 p.c. alcohol 8 parts, formalin 1.5 parts; glacial acetic acid 0.5 parts. The mixture should be made just before use and the specimen fixed for from 1 to 4 hours according to the size. As a stain for glycogen the slide is placed in a Borrel tube of distilled water with 25 drops of a saturated solution of aniline blue in dilute acetic acid. Sections are counter-stained in double strength Lugol's solution, differentiated in iodine alcohol, and mounted in paraffin oil. G. M. F.

A Simple Method for Staining the Myelin Sheaths of Nerve Fibres.—F. FEYRTER ("Über ein sehr einfaches Verfahren der Markscheidenfärbung, zugleich eine neue Art der Färberei," *Virchow's Arch.*, 1936, 296, 645-54). Tissues are fixed either in 10 p.c. formalin or in Orth's solution for 24 hours, then washed—in distilled water, and frozen sections cut 10-15 μ thick. Sections are mounted on slides and flooded with the following mixture: thionin (Grübler) 1.0 gm., tartaric acid 0.5 gm., distilled water 100 c.c. for 5 minutes. The sections are then covered with a cover-slip and excess stain is wiped off from the margin. The cover-slip is surrounded with cement (lanolin-colophonium mixture of Noyer). Sections should be examined with a day-light lamp; myelin sheaths stain a light red colour. G. M. F.

Staining with Tuchehtgelb G.—P. REZEK ("Über einige Erfahrungen mit der sogenannten Tuchehtgelbfärbung," *Zbl. allg. Path.*, 1937, 68, 356-58). Sections are stained with Weigert's iron hæmatoxylin, differentiated with 0.5 p.c. hydrochloride in 70 p.c. alcohol, washed for 2 minutes in running water, and stained for 5 minutes in the following solution: acid fuchsin 1 p.c. (Krall or Hollborn) in 1 p.c. acetic acid, 3 p.c. Tuchehtgelb G or GG (Ciba or Basel) in 1 p.c. acetic acid, phosphomolybdic acid 1 p.c., mixed in equal parts before use; after staining sections are rapidly before use; after staining sections are rapidly washed in tap-water, flooded for several minutes with 1 p.c. acetic acid in distilled water, washed for 30 seconds with 1 p.c. acetic acid in absolute alcohol, passed through alcohols, xylol, and mounted in salicylated balsam. Material fixed for a time in formalin fades rapidly, but material fixed in Susa or Carnoy is good after three years. G. M. F.

A Modification of Gray's Flagella Stain for Bacteria.—A. W. HOFER and J. K. WILSON ("Use of the Gray Flagella Stain for Slime-forming Bacteria," *Stain Technol.*, 1938, 13, 75-6). The bacteria are kept in sterile distilled water for from 10 to 40 minutes before staining. New slides should be used by preference and are prepared by placing in potassium bichromate solution for at least 10 minutes, thoroughly washed, and placed in 95 p.c. alcohol for 10 minutes or longer. The alcohol is burned off in a Bunsen flame and the slides heated over wire gauze. When the slides have cooled smears are made and placed in an incubator at 37° C. The slide is stained with the following mixture, 9 c.c. of Gray's solution 1 (saturated potassium alum solution 5 c.c.; 20 p.c. tannic acid 2 c.c., saturated mercuric chloride solution 2 c.c.) with 0.4 c.c. of solution 2 (saturated alcoholic basic fuchsin), filtered through paper. G. M. F.

Lucite as a Substitute for Canada Balsam.—O. W. RICHARDS and J. A. SMITH ("Lucite not a Substitute for Canada Balsam when mounting Microscopic Slides," *Science*, 1938, 87, 374). Lucite is a crystal-clear methyl methacrylate polymere which has a refractive index nearly the same as glass and is readily soluble in dioxan. Lucite also hardens rapidly and the mounts are firm enough for use in about an hour after they are mounted on a slide under a cover-glass. Unfortunately lucite dissolved in dioxan bleaches many important stains and the sections are less well cleared than they are in balsam or damar. G. M. F.

Glutathion in Mitochondria and Nucleolus demonstrated by Cadmium Salts.—P. JOYET-LAVERGNE ("Le glutathion du chondriome et du nucléole peut être mis en évidence par une nouvelle technique cytologique: la méthode des sels de cadmium," *C. R. Soc. Biol.*, 1938, 128, 59-61). A 1 p.c. solution of cadmium lactate in distilled water or in Ringer's solution added to glutathion results in the precipitation of glutathionate of cadmium at certain pHs. Unfortunately the glutathionate is colourless, but can be detected with a suitable microscopic apparatus. G. M. F.

Orienting and Embedding Small Objects.—J. B. BUCK ("A Device for Orienting and Embedding minute Organisms," *Stain Technol.*, 1938, 13, 65-8, 2 text-figs.). A device is described and illustrated for embedding objects of 200 μ or less in paraffin in accurate orientation. It consists of a small paraffin bath heated by a removable coil of wire and having a water jacket for rapid cooling of the block. Orientation is effected under the microscope with the use of electrically heated needles. G. M. F.

Staining the Anterior Pituitary of the Rat.—A. A. KONEFF ("Adaptation of the Mallory-azan Staining Method to the Anterior Pituitary of the Rat," *Stain Technol.*, 1938, 13, 49-52). The following technique differentiates sharply the three classical cell types found in the anterior pituitary of the rat. Pituitaries are fixed in Zenker formol solution, embedded in nitrocellulose, and cut at 3-4 μ . Sections are fixed to the slides before staining with albumin-glycerine and nitrocellulose is removed with oil of cloves. After treating sections with 70 p.c. iodized alcohol for 10 minutes and washing out the iodine with 70 p.c. alcohol, they are treated in aniline alcohol for 45 minutes (aniline 1 c.c., 90 p.c. alcohol 1000 c.c.), washed for 1-2 minutes in acid alcohol, and then stained in azocarmine solution at 56° C. for 2 hours (Azocarmine Grübler, 1 gm.; distilled water 100 c.c.; glacial acetic acid 1 c.c.). Wash in distilled water, differentiate in aniline alcohol till the cytoplasm is pink and the nuclei bright red; stop differentiation by immersion in acid alcohol for 1-2 minutes. Treat with 5 p.c. phosphotungstic acid for about 4

hours, rinse in distilled water, and stain in the following Mallory's solution for about 4 hours till the proper stain of basophils is obtained: Aniline blue Grübler 0.5 gm., Orange G Grübler 2.0 gm., oxalic acid 2.0 gm., distilled water 100 c.c., and phosphotungstic acid 5 p.c. 1 c.c. Wash in distilled water, treat with 5 p.c. phosphotungstic acid for 3-5 minutes, wash in distilled water, rinse in acidulated distilled water for 1 or 2 minutes, wash in distilled water, dehydrate, and differentiate in three changes of absolute alcohol; mount in euparal. G. M. F.

Cultivation and Staining of the Flagella of Root Nodule Bacteria.—R. M. STERN and W. B. SARLES ("A Method for Cultivating Root Nodule Bacteria to facilitate Staining of their Flagella," *Stain Technol.*, 1938, 13, 73-4). Organisms isolated from leguminous plant nodules were grown at 28° C. for 2-3 days on Laird's modification of Hitchner's medium; a second slope was inoculated from the first tube and from the second tube 1 drop of expressed water was transferred to a tube of liquid sodium citrate medium, or sodium succinate medium and incubated for 1-3 days at 28° C. Gray's method of staining flagella (*J. Bact.*, 1926, 12, 273) was used, but modified to the extent that the mordant and stain were allowed to remain on the slide for only 5 minutes. G. M. F.

Mounting Conifer Embryos.—J. T. BUCHHOLZ ("Dissection, Staining, and Mounting of the Embryos of Conifers," *Stain Technol.*, 1938, 13, 53-64, 3 text-figs.). As a substitute for commercial media such as euparal and diaphane, both of which contain gum sandarac, the following is suggested. To 2 parts of eucalyptus oil, redistilled for boiling-point between 175° and 177° C., is added 1 part of paraldehyde, redistilled for boiling-point 119-134° C. This forms an excellent solvent for gum sandarac. G. M. F.

A Contrast Stain for Gonococci and Meningococci.—B. R. SANDIFORD ("Contrast Stain for Gonococci and Meningococci in Smears," *Brit. med. J.*, 1938, i., 1155). The following contrast stain for gonococci and meningococci facilitates their detection in smears. Cells and nuclei are stained bluish green, Gram positive organisms purple-black, and Neisseriae red. Films are heat-fixed and flooded for half a minute with the following mixture: crystal violet 1 gm., 98 p.c. alcohol 20 c.c., and 1 p.c. aqueous solution of ammonium oxalate 30 c.c. Flood with triple-strength Lugol's iodine for half-minute, pour off the excess of iodine, and blot once; decolorize with acetone for 3 or 4 seconds; wash, counterstain for 2 minutes, flood off with water, and blot, but do not wash. The counterstain consists of malachite green (Grübler) 0.05 gm., pyronine (Grübler) 0.15 gm., and distilled water 100 c.c. The pyronine used is pyronine G, which is freely soluble in water. Crystal violet keeps for about a month and the counterstain for at least 3 weeks, possibly longer. G. M. F.

Demonstrating Ossification in Embryos.—G. W. RICHMOND and LESLIE BENNETT ("Clearing and Staining of Embryos for demonstrating Ossification," *Stain Technol.*, 1938, 13, 77-9, 2 text-figs.). After removing the abdominal and thoracic viscera through a median incision the embryo is fixed in 95 p.c. alcohol for two or more weeks. It is rinsed in tap-water and placed in 1 p.c. potassium carbonate for four or more weeks. The soft parts are cleared by placing the specimen in 1 p.c. KOH for 10 days or till the bones are clearly visible through the soft tissues. Wash in running tap-water for 12 hours. Stain for 30-60 minutes by submerging the specimen in a freshly prepared 0.1 p.c. aqueous solution of alisarine monosodium sulphonate to which 6-10 drops of 1 p.c. KOH are added. Wash in running tap-water for 30 minutes. Decolorize the deep purple soft parts

by submerging the embryo in an aqueous solution of 20 p.c. glycerine and 1 p.c. KOH for 1 or 2 weeks. Mount on a glass frame, passing slowly through ascending alcohols, and seal in a specimen jar in glycerine-alcohol.

G. M. F.

The Microtechnic of the Eye.—G. L. WALLS ("The Microtechnic of the Eye, with Suggestions as to Material," *Stain Technol.*, 1938, 13, 69–72). Fresh intact eyes are fixed for 24 hours in Kolmer's fluid (5 p.c. potassium bichromate 4 parts, 10 p.c. formalin 4 parts, glacial acetic acid 1 part, 50 p.c. trichloroacetic acid 1 part, and a saturated aqueous solution of uranyl acetate 1 part). The ingredients are mixed just before use, omitting the last two in the case of cold-blooded material. The tissues are dehydrated slowly and the eyes opened only in absolute alcohol by a clean razor blade cut, and the lens removed if desired. Embed in nitrocellulose by the hot-dry process, giving large eyes an extended hot or cold infiltration. Mallory's triple and Heidenhain's hæmatoxylin are the most useful stains.

G. M. F.

Staining Nervous Tissues with Activated Protargol.—D. BODIAN ("The Staining of Paraffin Sections of Nervous Tissues with Activated Protargol: the Rôle of the Fixatives," *Anat. Rec.*, 1937, 69, 153–62). The most suitable fixative was formol 5 c.c. glacial acetic acid 5 c.c., 80 p.c. ethyl alcohol 90 c.c. Both paraffin and celloidin techniques may be used. After taking sections down to distilled water they are placed for 12–48 hours at 37° C. in 100 c.c. of a solution of 1 p.c. protargol (silver albumose) containing 4–6 gm. of metallic Cu. Wash in distilled water. The protargol-Cu bath can be used only once. Place for 5–10 minutes in reducing solution consisting of hydroquinone 1 gm., Na₂SO₄ or 5 c.c. formol 5 gm., distilled water 100 c.c. Wash thoroughly in at least three changes of distilled water. Dehydrate and mount in balsam. If greater contrast is desired tone in gold as follows: place washed sections in a solution of 1 p.c. AuCl₃ containing 3 drops of acetic acid per 100 c.c. of solution until decolorized, wash in distilled water. Place in 1 or 2 p.c. oxalic acid until entire section has a faint purple or blue tinge. Wash in distilled water: remove residual silver salts in 5 p.c. sodium hyposulphite for 5 or 10 minutes. Wash in distilled water, dehydrate and mount in balsam.

G. M. F.

Protozoa.

Hyperparasitic Flagellates.—A. V. HUNNINEN and R. WICHTERMAN ("Hyperparasitism: a Species of *Hexamita* (Protozoa, Mastigophora) found in the Reproductive Systems of *Deropristis inflata* (Trematoda) from Marine Eels," *J. Parasit.*, 1938, 24, 95–100, 1 pl.). Description of a new *Hexamita* parasitic in the organs of reproduction of a trematode, *Deropristis inflata*, which itself is an intestinal parasite of the eel, *Anguilla chryspa*. Though the flagellate sometimes occurs in the intestinal contents of eels harbouring infected trematodes, it is absent from those free of the trematodes or containing uninfected ones.

C. A. H.

Inheritance of Immunity against Trypanosomes in Rats.—J. T. CULBERTSON ("Natural Transmission of Immunity against *Trypanosoma lewisi* from Mother Rats to their Offspring," *J. Parasit.*, 1938, 24, 65–82). In a series of observations and experiments the author has shown that the offspring of mother rats which have recently recovered from an infection with *T. lewisi* are immune to infection with this parasite for the first few weeks of their life. The resistance depends upon the passive transfer from the mother of specific antibodies by way of the placenta and by the milk, and is not due to active infection of the young

in utero or after birth. The young of normal mothers become resistant when suckled upon immune females. Immunity is also conferred to the young of a normal mother if she becomes infected during the nursing period. C. A. H.

Acquired Immunity against Chagas' disease.—J. T. CULBERTSON and M. H. KOLODNY ("Acquired Immunity in Rats against *Trypanosoma cruzi*," *J. Parasitol.*, 1938, **24**, 83–90). The authors have established experimentally that rats which have recovered from an infection with *Trypanosoma cruzi* are insusceptible to reinfection with this parasite, and their serum confers partial protection to normal rats, the infection on inoculation of the trypanosome being of a low grade. Immune serum is only partially effective therapeutically, and is unable to reach the trypanosomes once they have established themselves in the tissue cells, its action being limited to the blood-forms. C. A. H.

New Classification of Hæmosporidia.—A. CORRADETTI ("Una nuova classificazione degli 'Hæmosporidiidea' basata sull'esistenza di un ciclo schizogonico dei Plasmodi nelle cellule dei tessuti," *Atti R. Accad. Naz. Lincei*, 1938, (VI) **27**, 31–2). The Hæmosporidian family Hæmoproteidæ has hitherto been separated from the family Plasmodiidæ on the grounds that its members undergo schizogony in the inner organs, especially in cells of the reticulo-endothelial system, without the production of pigment. The recent discovery of the same type of development in a number of avian species of *Plasmodium* has rendered this distinction invalid, and the author accordingly proposes to unite the above-named two families into one—*Plasmodiidæ* Mesnil, 1903. C. A. H.

Hæmoproteus from American Duck.—C. M. HERMAN ("*Hæmoproteus* sp. from the Common Black Duck, *Anas rubripes tristis*," *J. Parasit.*, 1938, **24**, 53–6, 1 fig.). Description of a *Hæmoproteus* from *Anas rubripes tristis*, reported for the first time from a North American duck. A list is given of various forms of this blood parasite hitherto recorded from ducks, with the differential characters of their gametocytes. C. A. H.

Development of Sporozoites of Plasmodium.—A. MISSIROLI ("Sullo sviluppo dei parassiti malarici," *Atti R. Acad. Naz. Lincei*, 1938 (VI) **27**, 33–4). Description of the development of the sporozoites of the avian malaria parasite *Plasmodium relictum*. The forms produced in the salivary glands of the mosquito and commonly known as sporozoites are regarded by the author as sporocysts. In these the nucleus is said to divide until from four to eight nuclei are produced, each of which enters into the composition of a true sporozoite. The nuclear divisions may proceed in the salivary glands of the insect or after inoculation into the vertebrate, but the sporozoites are liberated in the latter host, in which they penetrate into various cellular elements (erythrocytes, endothelial cells, and others) and continue their life-cycle. C. A. H.

Pseudomassilina, New Genus and Type of Shell Formation.—E. LACROIX ("Sur une texture méconnue de la coquille de diverses Massilines des mers tropicales," *Bull. L'Inst. Oceanog.*, May 1938, No. 750, 1–8, text-figs. 1–4). The tests of the imperforate Foraminifera have hitherto been regarded as an entirely structureless deposit of calcium carbonate. Observing that the type of *Massilina M. secans*, had a smooth and polished shell while some other species of the genus had an unpolished or pitted surface texture, the author examined a series of unpolished specimens and has conclusively proved by means of sections and other methods that the shell wall consists of three separate layers: a central layer composed of irregularly shaped granules or blocks separated from each other by an

intricate network of very fine canals; an external layer of a single series of "palisade" granules whose depth exceeds their breadth; and an internal layer composed of a single layer of cubical granules. The external and internal layers are perforated by straight extensions from the fine canals of the central layer, their diameter does not exceed 0.25μ , but their apertures on the external surface give the characteristic unpolished or pitted surface texture. Several species already described as belonging to the genus *Massilina* present this structure. They appear to be confined to tropical seas, and the author proposes a new genus, *Pseudomassilina*, for their reception. The plan of growth is in all other respects identical with the typical *Massilina*, having a smooth and polished test. The newly discovered structure is clearly illustrated in a transverse section photographed by M. Auguste Lumière.

A. E.

Australian Polymorphinidæ.—W. J. PARR and A. C. COLLINS ("Notes on Australian and New Zealand Foraminifera, No. 3. Some Species of the Family Polymorphinidæ," *Proc. Roy. Soc. Victoria*, 1937, 50 (N.S.), Pt. 1, 189–211, pls. 12–15, text-figs. 1–7). As a result of the study of several thousand specimens of the family both recent and Tertiary fossils the authors have recorded thirty-five species and varieties from Australia and New Zealand, representing eight of the genera established by Cushman and Ozawa in their monograph (1930). Ten of the species and varieties are described as new, all of them being of restricted distribution, and the fossils should therefore be of value to the micro-palæontologist. Very full details of distribution are given for all the species, which are admirably illustrated by the junior author.

A. E.

Structure of Bathysiphon.—J. LE CALVEZ ("Un foraminifère géant *Bathysiphon filiformis* G. O. Sars," *Archiv. Zool. Exper. et Gen.*, 1938, 79, No. 2, 82–8, text-figs. 1–2). *B. filiformis* is not uncommon at Villefranche-sur-Mer in depths of 150–250 metres and attains 2 inches in length. The tube is easily laid open with a scalpel, and the protoplasmic body when removed exhibits a terminal mass of a whitish colour and ectoplasmic nature. Below this the dark-brown protoplasm contains numerous large round nuclei, smooth, hyaline, and readily separable. The protoplasm also contains an accumulation of faecal residues mixed with spicules, mica, sand-grains, etc. Contrary to recognized diagnoses, the tube is not open at both ends, the distal end being closed by a thin disc of material similar to that of the tube. Several centimetres higher one often finds a similar transverse septum. The protoplasm is thus divided into two unequal sections: the larger communicating with the exterior and containing nuclei; while the smaller section, enclosed between the internal and terminal septa, contains no nuclei and the protoplasm is deep black in colour and obviously dead. This terminal portion is easily detached and such fragments are commonly found in dredgings. It explains why the tube of *Bathysiphon* does not grow to an indefinite length, for while one end lengthens, the other is amputated. The structure of the nuclei of types A and B is described and illustrated.

A. E.

An Eocene Fossil.—J. H. F. UMBGROVE ("A Second Species of *Biplanispira* from the Eocene of Borneo," *Leidsche Geol. Meded.*, 1938, 10, No. 1, 82–9, 17 figs. from photographs of sections). The Author describes and figures a new species, *Biplanispira absurda*, from Eocene limestones in Borneo, where it occurs with many other fossils indicating very shallow water on or near reefs. The presence of a marginal cord proves that the genus belongs to the family Camerinidæ, while the structure of the central part indicates close relationship to the genus *Pellatispira*.

A. E.

Foraminifera from Heligoland.—L. RHUMBLER. ("Foraminiferen aus dem Meeressand von Heligoland, gesammelt von A. Remane (Kiel)," *Kieler Meeresforschungen*, 1938, 157–222, text-figs. 1–64). A very elaborate and characteristic paper on sixteen forms from shallow water. Four new genera are created, *Causia*, *Spirillinoides*, *Remaneica*, *Earlmiersia*, and nine new varieties, five of them being allotted to the single species *Trochammina squamata*. The paper also includes a section devoted to a new "Kammerungs-Diagrammformel" for the spiral Foraminifera, which is beyond the grasp of this abstractor. The formulæ given for each variety give a mathematical appearance to the whole paper and it is doubtful whether so many measurements would repay the time involved. A. E.

Cretaceous Gumbelinae.—J. A. CUSHMAN ("Cretaceous Species of *Gumbelina* and Related Genera," *Cont. Cush. Lab. For. Res.*, 1938, No. 193, 2–28, pls. 1–4). *Gumbelina* has a very wide range according to the literature, the earlier forms having been referred to *Textularia*. Many of Ehrenberg's species can no longer be identified from his balsam-mounted types, and such specific names must lapse. *Gumbelina* may possibly have been pelagic; it has many features common to the pelagic genera and is often extremely abundant, especially in association with Globigerinidae and Globorotaliidae. From it in the Upper Cretaceous a number of specialized genera were developed, most of which have very definite ranges and became extinct before Tertiary times. All the recorded species of *Gumbelina* and the related genera *Gumbelitria*, *Rectogumbelina*, *Pseudotextularia*, *Planoglobulina*, and *Ventilabrella* are described and well illustrated, as also are those species of Ehrenberg which the author regards as unidentifiable, the original figures of Ehrenberg being reproduced in their case. There are ten new species of *Gumbelina* and one each of *Rectogumbelina*, *Planoglobulina*, and *Ventilabrella*. A. E.

Arthropoda.

A New Parasitic Mite.—TUBB ("Reports of McCoy Society on Lady Julia Percy Island. Arachnida," *Proc. Roy. Soc. Vic.*, 1937, 49 (N.S.), 417–8, text-figs. 1–4). In his monograph (1936) on the German Hydracarina, Viets adds a section on "andere Milben des Wassers" to cover those mites belonging to groups other than the Hydrachnellæ and Halacaridae. Included in these other mites is the genus *Halarachne*, for which Oudemans created the family Halarachnidae. So far, only eight species have been recorded and in almost all cases as parasites in the nasal passages of marine animals. A ninth species—*Halarachne reflexa*—has now been added by Tubb. This was found in the nasal passages of the Tasmanian sea-bear (*Arctocephalus tasmanicus*), all the hosts examined being heavily infected. Types in National Museum, Melbourne. BM/HNDH

Mites from Portuguese West Africa.—WALTER ("Contribution à l'étude du Plancton d'eau douce d'Angola," *Arch. Hydrobiol.*, 1937, 32, 503–9, 8 text-figs.). Angola has not hitherto appeared in the geographical distribution of watermites, but a small collection turned over to the author by Dr. A. Monard extends the area of distribution of six species recorded towards the south-west of Angola. A new species, *Encentriflorus tumidus*, is also added. BM/HNDH

Some New Watermites from Jugoslavia.—K. VIETS ("Über einige Wassermilben aus Jugoslawien," *Zool. Anz.*, 1937, 120, 294–301, 10 text-figs.). A small collection made by Dr. Karaman yielded in addition to a new species, *Atractides connexus*, *Megapus spinipes*, *Nautarachna crassa* (*teleiophan*) and *Brachypoda* (*p.*) *montii*. With the exception of *Megapus*, the species noted are additions to

the Jugoslavian fauna, which now numbers 145 species of watermites. The new species is *Pionella karamani*, which so differs from the Pioninæ as to call for a new genus and a new sub-family. The main points of distinction briefly are: body dorsally and ventrally highly chitinated, the lateral edges less, so as to allow for a measure of bodily elasticity. Maxillary plate without posterior process. Fourth segment of palpi distally without the chitinous peg of *Piona*. Acetabula without discs and represented only by pores on the ventral surface. Genital plates, epimera, and ventral plate fused into one. The hitherto unknown female of *Brachypoda* (*P*) *montii* is now described.

BM/HNDH

Lebertia barsica.—SZALAY ("Eine neue Hydracarine aus der Gattung *Lebertia* Neuman," *Zool. Anz.*, 1937, **119**, 40-3, 2 text-figs.). This new species is one of the small species, and has certain affinities with *L. stigmatifera* and Halik's wrongly named *pusilla* (which Szalay has renamed *L. haliki*), on the one hand, and with *cuneifera* on the other. Two noticeable features are the closeness of the insertion of the small hairs on the flexor surface of P. IV. and the form and position of the anal aperture.

BM/HNDH

Biospeological Studies in Belgium.—K. VIETS ("Etudes biospeologiques. IV. Hydrachnellæ et Porohalacaridae (Acari). II (1)," *Bull. Mus. Hist. nat. Belg.*, 1937, **13**, No. 6, 1-12, Figs. 1-15). In 1936 Leruth investigated certain Belgian subterranean waters, but found no Hydrachnellæ, although two halacarids were taken. His investigations of 1937 yielded the first subterranean hydracarid for Europe outside of the Balkan area, *Feltria subterranea*, n.sp. It is to be noted that the eyes of this new species are extremely small, with the eye pigmentation correspondingly reduced. Of the *Porohalacarids*, the nymph of *Walterella weberi* and the larva of *Soldanellonyx chappuisi* were also taken.

BM/HNDH

A New Pontarachna from South Australia.—WOMERSLEY ("A New species of Marine Hydrachnellæ from South Australia," *Trans. Roy. Soc. S. Aust.*, 1937, **61**, 173-4, text-figs. A, B, C). Of the marine Hydrachnellæ only three genera are recognized, and together they cover very few species. Possibly a closer scrutiny of marine material might disclose more. *Pontarachna halei* is recorded as an addition to the marine Hydrachnellæ. Two specimens only were taken, the first from the reef at Sellick's Beach in sargassum and the second from Reevesby Island. The specimens are stated to be "very close indeed to *P. punctulum* from the Bay of Naples, but appear to differ in the minute details of the pores and setæ on the ventral surface." The setæ are not shown on the figure, an important omission as they form one of the distinguishing features of *Pontarachna* and *Litarachna*. The new species is described as a female, but the figure shows the genital aperture surrounded by a complete chitinous ring, which is a feature of the male. In the female the aperture is enclosed in a ring divided into two halves more or less widely separated.

BM/HNDH

Watermites New to the Roumanian Fauna.—HUSIATINSCHI ("*Arrenurus strandi*, eine neue Hydracarineneart aus der Bukowina (Rumänien)," *Festschrift für Prof. Dr. Embrik Strand*, 1937, **2**, 369-70, 4 text-figs.; "Hydracarinene aus der Bukowina (Rumänien)," *ibid.*, 1937, **3**, 265-74, 27 text-figs.; "Drei neue Hydracarinenearten aus dem Hochmoorgebiet Mihodra in der Bukowina (Rumänien)," *Arch. Hydrobiol.*, 1937, **31**, 547-52, 11 text-figs.). The first contribution describes as a new species *Arrenurus strandi*. This is a female which is stated to belong to the subgenus *Truncaturus*, but it is not stated on what grounds it is so placed, as it is admitted that it differs from all other known females of that subgenus. The male

is not known. The second contribution adds a number of species to the Roumanian fauna. The third describes as new, *Piona motasi*, *Neumania vietsi*, and *Arrenurus ventriosipalpis*.
BM/HNDH

Bukowinan Hydracarina.—HUSIATINSCHI ("Fauna Hydracarinelor din bahna 'Mihodrei' (Bucovina)," *Bul. Fac. Sti. Cernauti*, 1937, 11, 49-133, 79 text-figs. and a sketch-map). This is a thesis for the doctorate of the Faculty of Science of Cernowitz in Roumania. It deals in a systematic, ecological, and zoo-geographical manner with the fauna of the Mihodrei, a high-lying moorland area through which the Mihodra and Mihoderca flow. Neighbouring streams were also examined, with the result that 103 species out of twenty-seven genera are now known from this area, bringing the total for Roumania up to 176 species of thirty-nine genera. *Hydrachna (Diplo.) hormuzakii* and *Eylais prelipceani* are new species.

BM/HNDH

Virus Diseases.

The Diagnosis of Alastrim.—C. MAGARINOS TORRES and J. DE CASTRO TEIXEIRA ("Methodo para diagnostico do alastrim," *Mem. Instituto Oswaldo Cruz.*, 1937, 32, 543-50, 3 pls.). The inclusion bodies of alastrim seen in material from seven epidemics occurring in several States of Brazil from 1932 to 1937 were consistent in their morphology and staining properties. Paranuclear or circum-nuclear basophilic cytoplasmic bodies not stained by safranine, single or in pairs at opposite ends of the nuclei, could always be demonstrated in epidermal cells from skin lesions either in man or in the rhesus monkey. Cytoplasmic inclusion bodies of *Variola vera* as seen in human cases and of vaccinia as seen in rhesus monkeys are acidophilic or polychromatophilic and deeply stained by safranine. A method of diagnosis consists in inoculating the material into rhesus monkeys and investigating the morphology and staining properties of the resulting cytoplasmic inclusions.
G. M. F.

Fibro-epithelial Growths in Turtles.—G. M. SMITH and C. W. COATES ("Fibro-epithelial Growths of the Skin in Large Marine Turtles, *Chelonia mydas* (Linnaeus)," *Zoologica* 1938, 23, 93-8, 18 pls.). Cutaneous fibro-epithelial growths were found in the skin of large marine sea turtles, *Chelonia mydas*. L., in the New York Aquarium and under natural conditions. No malignant changes were noted, but the appearances resemble those found in virus papillomata.
G. M. F.

BOTANY.

(Under the direction of J. RAMSBOTTOM, O.B.E., D.Sc.)

Histology.

Distribution of Xylem Rays in Conifers.—M. W. BANNAN ("Observations on the Distribution of Xylem-ray Tissue in Conifers," *Ann. Bot.*, 1937, N.S. 1, 717-26, 1 pl., 1 fig.). Much of the variation observed in the height and distribution of rays in the stem and branch wood of conifers is correlated with ring-width, distance from the pith, and in the case of branches, position on the upper or lower side. At the same distance from the pith specimens with wide growth rings have the higher rays. The distribution of rays, as measured by the number per unit of tangential section, also varies with ring-width, the relation here being of the inverse type. In branches showing a marked development of compression wood on the under side the rays are more numerous and somewhat lower in height than on the upper side. The height and distribution of rays in roots varies more widely. In most of the Abietinæ the rays in the "buried" type of root are usually considerably higher than in "exposed" roots, stems, and branches of similar size and age. In *Thuja* the rays are lower, with less difference between root and branch. In *Taxodium* the rays are lowest in the "buried" roots. In most conifers, ray tracheids are less numerous in "buried" roots than in other parts of the tree, but in *Taxodium* the opposite condition sometimes exists. B. J. R.

Anatomical Structure of Nodes.—E. P. SMITH ("Nodal Anatomy of Some Common Trees," *Trans. and Proc. Bot. Soc. Edin.*, 1937, 32, 260-77, 11 figs.). *Quercus*, *Acer*, and *Tilia* correspond to Sinnott's tri-lacunar type; *Platanus* to his multi-lacunar type. In all four types the median leaf-trace contribution and the bud contribution persist through one leaf pattern only, making way for the corresponding contributions from the leaf immediately below the leaf of origin. The number of internodes involved in one-leaf pattern varies with the phyllotaxis, being two in *Platanus*, *Acer*, and *Tilia* and five in *Quercus*. The median leaf-trace at the time of its amalgamation with the main stele consists in *Tilia* of one segment, in *Acer* of three segments, in *Platanus* of four, and in *Quercus* of five segments. The lateral leaf-trace contributions in all cases persist for a considerably longer time than the median, enduring for several leaf patterns before fading out. Just before the entry of the leaf-traces the main stele shows a considerable transverse expansion and the gaps appear as wide bands of parenchyma. B. J. R.

Leaf Anatomy of Cucurbitaceæ.—H. L. CHAKRAVARTY ("Physiological Anatomy of the Leaves of Cucurbitaceæ," *Phil. J. Sci.*, 1937, 63, 409-31, 11 pls.). The general anatomy of the leaves of twelve species of eight genera is described. Extra-floral nectaries are present in the leaves of *Cephalandra indica*, *Luffa* spp., and *Lagenaria vulgaris*. Heterophanous branched cystoliths enclosed in enlarged lower epidermal cells occur in the leaf of *Momordica cochinchinensis*. The genus *Momordica* alone shows the presence of solitary, clustered, or twin crystals and crystal dusts of various structures. The arrangement, number, and nature of

the vascular bundles in the midribs and petioles of cucurbitaceous leaves are diagnostic for genera and sometimes for species. Water stomata and hydathodes are commonly present. The leaves of *Cucurbita Pepo*, *Luffa acutangula*, and *Momordica cochinchinensis* bear peculiar hairy coverings; calcium crystals, known as pseudocystoliths, are deposited in some of the hairs. On the basis of the anatomy of the leaf in the Cucurbitaceæ the relationship of the genera may be traced from the evolutionary standpoint. B. J. R.

Cork Formation in Veronica.—R. G. GRAY ("Cork Formation in *Veronica Lyallii*," *Trans. and Proc. Bot. Soc. Edin.*, 1937, 32, 362-7, 13 figs.). The type of periderm formation in this species is comparable to the "etagenkork" seen in some Monocotyledons and does not appear to have been recorded previously in a Dicotyledon. The hypoderm first appears in the leaf-bases immediately under the piliferous part of the epidermis. As the leaf-bases never fuse simultaneously on both sides of the stem a hypoderm may be well developed on one side before it has been differentiated on the other. Just above the node the hypoderm begins to disappear opposite the petioles of the pair of leaves at that node. When the leaf-bases fuse the hypoderm has completely disappeared. It reappears in the fused flanges of the leaf-bases and gradually surrounds the stem once more. After a certain age, therefore, the stem is clothed by a discontinuous hypoderm, the interruptions occurring at the nodes. In older stems three or more corky layers may be present and later the phellogen becomes patchy. It goes continually deeper into the cortex, but never becomes stelar. There does not appear to be a connection between the age of the stem and the number of corky layers present, but it is difficult to be sure on this point as the wood does not show regular growth rings and so it is difficult to determine the exact age of the plant. B. J. R.

Comparative Anatomy of the Hypericaceæ and the Guttiferæ.—P. A. VESTAL ("The Significance of Comparative Anatomy in establishing the Relationship of the Hypericaceæ to the Guttiferæ and their Allies," *Phil. J. Sci.*, 1937, 64, 199-256, 9 pls., 3 figs.). The morphology and minute anatomy of the Hypericaceæ, Guttiferæ, and allied families are described with special reference to the microscopic anatomy of their woods. It is concluded that vascular anatomy is especially useful within large complexes in indicating levels of development and in the disposition of debatable groups. Correlations between the dimensions, perforation plates, and pitting of vessel members, the pitting and dimensions of fibre-tracheids, and the type of rays are of particular phyletic value in this study. The groups investigated fall into two major complexes, namely, the Parietales and the Guttiferales of Wettstein, or alternatively the Parietales of Engler and Prantl with its attendant sub-series. The former treatment is preferred. The Dilleniaceæ, Theaceæ, and Flacourtiaceæ are considered as possible groups within the complex from which the other lines have radiated. The Canellaceæ are considered to be more closely related to the Myristicaceæ and the arboreal Ranales than to the above groups. The Hypericaceæ are considered to be a logical outgrowth from the Guttiferæ. The plates illustrating this paper include fifty-four photomicrographs of wood sections. B. J. R.

Anatomy of *Ligusticum scoticum*.—M. LUNAN ("Anatomical Investigations on *Ligusticum scoticum*," *Trans. and Proc. Bot. Soc. Edin.*, 1937, 32, 353-61, 1 pl. 7 figs.). In the seedling the transition from cotyledonary to radical vascular structure takes place within 0.3 mm. at the top of the hypocotyl. The phloem groups of the cotyledonary median bundle divide and the branches fuse with the phloem groups of the lateral bundles in the intercotyledonary plane; the

transition from endarch to exarch xylem is achieved by the metaxylem passing down on either side of the protoxylem more obliquely than the protoxylem itself. There are curious convoluted radiating strands of starch-storing tissue in the adult root due to unequal strains set up by secondary growth between the rigid xylem and the confining cork tissue. The uppermost leaf is shown to be more xeromorphic than the radial leaves. The nodal anatomy is described, the normal plan indicated, and the exceptions described.

B. J. R.

Wood Structure of the Celastrales, Olacales, and Santalales.—S. J. RECORD ("The American Woods of the Orders Celastrales, Olacales, and Santalales," *Trop. Woods*, 1938, **53**, 11–38). This paper is part of a comprehensive survey of the woods of the western hemisphere, and is concerned with the trees and large shrubs of nine families, viz. Aquifoliaceæ, Celastraceæ, Cyrillaceæ, Hippocrateaceæ, Icacinaceæ, Olacaceæ, Opiliaceæ, Loranthaceæ, and Santalaceæ. The wood structure of these families and some of the more important genera is described. The woods of the tribe Opiliæ, of the family Opiliaceæ, are unique in possessing cytoliths of calcium carbonate in some of the ray cells; these structures are apparently absent from the wood of *Agonandra* of the tribe Agonandreæ. The woods of these three orders constitute a heterogeneous group, and this heterogeneity applies also to the larger families, especially the Celastraceæ and the Santalaceæ. The timbers are of minor commercial importance although several of them are used locally.

B. J. R.

Wood Anatomy of Flindersia.—E. S. HARRAR ("Notes on the Genus *Flindersia* R. Br. and the Systematic Anatomy of the Important Flindersian Timbers indigenous to Queensland," *J. Elisha Mitchell Sci. Soc.*, 1937, **53**, 282–91, 3 pls.). A systematic study of the wood of ten of the more important species of *Flindersia* has revealed physical and anatomical differences sufficient to permit of specific identification. The woods of this genus combine characteristics of both the Meliaceæ and the Rutaceæ. The author favours the formation of a new monotypic family, Flindersiaceæ. Photomicrographs of transverse and tangential sections of the woods are included.

B. J. R.

Stem Anatomy of Rhododendrons.—C. M. CANT ("Stem Structure in the Maddenii Series of Rhododendrons," *Trans. and Proc. Bot. Soc. Edin.*, 1937, **32**, 287–90, 1 pl., 2 figs.). An unusual feature in the Maddenii Series of Rhododendrons is a dilation which occurs at the base of the stem. Frequently there is a tendency for the dilation to give rise to several shoots at its apex instead of tapering off to give one main axis. Microscopic examination of the dilated region in stems of varying ages from one to nineteen years reveals no structural abnormality. The explanation of the swelling lies in the quantity of the tissues present and not in their quality, and is due to extra development of wood, phloem, and periderm. This is presumed to allow for increased storage of food reserves and is probably correlated with the epiphytic tendency of this Series of Rhododendrons and a preference for a rocky habitat which makes the additional supply of food reserves particularly useful. The large woody base also provides additional strengthening tissue which is a useful acquisition having regard to the epiphytic habit.

B. J. R.

Tension Wood in Beech.—S. H. CLARKE ("The Distribution, Structure, and Properties of Tension Wood in Beech (*Fagus sylvatica* L.)," *Forestry*, 1937, **11**, 85–91, 2 pls.). Tension wood is developed on the upper sides of the leaning parts of trunks. Microscopically, the chief peculiarity of tension wood is the gelatinous

appearance of the secondary walls of the fibres, which react in the standard cellulose stains and reagents. Gelatinous fibres occur chiefly in the earlier parts of the growth rings and never in the last few rows of cells of the year's growth. Compared with normal wood of equal density, tension wood is exceptionally weak in compression parallel to the grain; in tensile strength and toughness it is slightly stronger. The longitudinal shrinkage of tension wood in drying from green to the oven-dry condition is abnormally high.

B. J. R.

CRYPTOGAMIA.

Pteridophyta.

Isoëtes.—CHARLES LA MOTTE ("Morphology and Orientation of the Embryo of *Isoëtes*," *Annals of Botany*, 1937, N.S. 1, 695–715, 20 figs. and 1 pl.). A detailed study of the embryo of *Isoëtes* in its earliest stages under controlled conditions, with a view to determining the possible effect of gravity upon its form and orientation. Gametophytes fixed in a horizontal position produced embryos with first leaf and first root in a vertical position; and when fixed in a vertical or inverted position produced embryos with first leaf and root in a horizontal position. When horizontal gametophytes were turned upside-down about 18–24 hours after fertilization, the embryos were inverted also; but when the gametophyte was turned over in less than 18 hours after fertilization the embryo was not inverted. It was found that the primary wall of the embryo is formed some 18–24 hours after fertilization in an oblique position relative to the archegonial axis and with the edge nearest the neck always in that side of the apical half of the archegonium closest to the direction of the zenith. Furthermore, this wall is situated at right angles to a plane including both a line of gravitational force and the archegonial axis. The further divisions and development of the young embryo are described. The suggestion is made that the Isoëtaceæ deserve to be set apart as a separate order, the Isoëtales.

A. G.

Proliferation in Ferns.—ILDA McVEIGH ("Vegetative Reproduction of the Fern Sporophyte," *Bot. Review*, 1937, 3, 457–97). Proliferation occurs in many species of ferns: (1) normal vegetative reproduction from leaves and stolons; (2) vegetative reproduction from roots; (3) apospory; (4) induced proliferation. Lists are given of all ferns which fall respectively into these four classes, with references to literature where the facts are described. Where histological study has been made of the origin of the proliferation it has been found to start in unspecialized cells at the tip of the leaf or in epidermal cells; and in roots from cells of the apical meristem and possibly from root cortex; proliferation by artificial stimuli has been induced from cells of epidermis, parenchyma, callus, and meristem. And in general the cells concerned in proliferations of ferns appear to be unspecialized or not highly specialized.

A. G.

Bryophyta.

Thalloid Hepatics.—ROBERT DOUIN ("Morphoses de quelques Hépatiques à Thalle," *Ann. Sci. Nat. Bot.*, 1937, Sér. 10, 19, 167–80, 9 figs, 2 pls.). Description and figures of the remarkable changes in the morphology of such liverworts as *Fegatella* and *Reboulia*, when the plants are grown for one or more years in an atmosphere saturated with water vapour. The thallus of *Fegatella* grows upwards divided into a multitude of slender ligulate ramifications, totally different from the normal habit; and the thalline structure is remarkably reduced and simplified; the epidermis remains, the stomata are present, but the parenchymatous tissue and

chlorophyll layer have disappeared, the air-chambers are few, and chlorophyll corpuscles are present in all the remaining cells of the thallus, the scales produced gradually become smaller in size and lose their auricle. The cells nearly all retain the normal size, but their walls are exceedingly thin. In *Reboulia* the reduction of the tissues is not so extreme. A. G.

Blasia.—C. DOUIN ("Le thalloïde du *Blasia* et son extraordinaire organisation," *Rev. Gén. de Bot.*, 1937, **49**, 637–64, 5 pls.; 682–704; 752–63). A detailed account and explanation of the remarkable morphology and development of *Blasia*, which differs in various ways from all other hepaticæ. The apical cell has a double function, for it cuts off a series of segments which give rise to the costa of the thallus, and a series of secondary initial cells which produce all the organs which are juxtaposed to the costa. These secondary initials are lateral and ventral; the lateral give rise to the wings of the costa and to the thalline leaves; and the ventral produce the ventral compound papillæ crowned with their amphigastria. Further, when the initial does not produce a fructification, it divides into a number of initials which develop into stellate propagula. *Blasia* has two kinds of leaves, which are radically different, namely the thalline leaves, each the product of a secondary initial and inserted longitudinally, and non-thalline leaves, which arise from special primary segments and are comparable with the leaves of other hepatics. The compound papillæ are a feature peculiar to *Blasia*; their function is to protect the young initials which later will produce new plants. The peculiar stellate propagula of *Blasia* are more or less developed young shoots. The thallus of *Blasia* is a compound structure, produced not from a single apical cell but from a number of initials arising in succession, developing independently of one another, and producing a number of thalli juxtaposed end to end or laterally. The habitual sterility of *Blasia* is due to the ruthless action of *Nostoc*, which invades its tissue and destroys the initials of its compound papillæ as well as the mother cells of its antherozoids, and prevents the formation of archegonia. A. G.

Thallophyta.

Alge.

Sizes of Diatoms.—WALTER GARSTANG ("On the Size-Changes of Diatoms and their Oceanographic Significance," *J. Marine Biol. Assoc.*, 1937, **22**, 83–96, 9 figs.). The life-history of diatoms, with the gradual reduction of size during a series of binary fissions and the periodic restoration to the original size after production of auxospores, is discussed with special reference to the measurements of *Rhizosolenia styliformis* given by R. S. Wimpenny in his paper "The Size of Diatoms" (*op. cit.*, 1936, **21**, 29–60). A survey is made of the spring and autumn characters of the *Rhizosolenia* populations in the regions of the Dogger Bank, the North-west Deep, and the south and west coastal areas during the years 1932–34, and reasons are given for presuming that there was an influx of Atlantic waters and plankton over the Bank in 1933, and no such occurrence in 1934. A. G.

Diatoms and Iron.—H. W. HARVEY ("The Supply of Iron to Diatoms," *J. Marine Biol. Assoc.*, 1937, **22**, 205–19, 2 figs.). The nature of iron as it occurs in sea-water and its utilization by diatoms are discussed. Marine diatoms acquire many thousand times more iron than theoretically they can obtain by diffusion of iron ions from the surrounding sea-water. There is evidence that ferric hydroxide is readily adsorbed on the surface of diatoms, and that colloidal and larger particles of ferric hydroxide or phosphate can be utilized by diatoms and aid their growth. Fresh-water diatoms (*Nitzschia* and *Lauderia*) thrive on a minute quantity of iron

compared with that found on and in diatoms of the open sea. It is claimed that iron hydroxide adsorbed on diatoms is in contact with an interface where its solution and subsequent passage into the cell are probable. A. G.

Rare Diatoms.—F. MEISTER ("Seltene und neue Kieselalgen," *Ber. Schweiz. Bot. Ges.*, 1935, **44**, 87–108, 10 pls.). Three lists of diatoms with description of new species: (a) seventeen species from high altitudes in Switzerland, including five species and a variety new to science; (b) twenty-nine species from Honduras, fifteen of these and three varieties being new; (c) forty-three species from China and Japan, eighteen of these and six varieties being new. The ten plates contain ninety-six photographs of diatoms. A. G.

Subaërial Diatoms.—B. V. SKVORTZOV ("Subaërial Diatoms from Hangchow, Chekiang Province, China," *Bull. Fan Memorial Inst. Biology*, 1937, **7**, 219–30 1 pl.). A list of twenty-four diatoms found in tufts of mosses from a rocky cave in the environs of Hangchow. Figures and diagnoses are given. Three species and two varieties are new to science. These muscicolous diatoms are all minute and mostly have a thin siliceous membrane and coarse striations. A. G.

Australian Diatoms.—B. V. SKVORTZOV ("Notes on Fossil Diatoms from New South Wales, Australia. I. Fossil Diatoms from Diatomaceous Earth, Cooma, N.S.W.," *Proc. Linn. Soc. New South Wales*, 1937, **62**, 175–80, 26 text-figs.). A brief sketch is given of previous publications on Australian diatoms, and a description is given of the nature of the deposit near Cooma from which the present sample was taken. The method of cleaning the material is explained. The diatoms were found to be mostly in a fragmentary state belonging to fresh-water genera, but not sufficient for specific determination. Nine species and a variety were identified and are figured, including a new species *Stauroneis* (*Pleurostauron*) *Playfairiana* and a new variety of *Melosira undulata*. The conclusion is drawn that the sample is of lacustrine origin and of middle Tertiary age. Three marine diatoms were found, and their occurrence requires further investigation. A. G.

British Algæ.—J. W. G. LUND ("Contributions to our Knowledge of British Algæ. VI. Some New British Algal Records—I," *J. of Bot.*, 1937, **75**, 305–14, 4 figs.). A list of fifteen rare microscopic algæ collected on the sediment of four ponds in Richmond Park; and descriptive notes and figures of the following: *Holopedium geminatum* Laut., *Cylindrospermum alatosporum* Fritsch, *Trachelomonas varians* Defl., *Chrysamæba radians* Klebs, *Mallomonas akromonas* Ruttner, *Mesostigma viride* Laut. A. G.

Cephaleuros on Citrus.—J. R. WINSTON ("Algal Fruit Spot of Orange," *Phytopathology*, 1938, **28**, 283–86, 2 figs.). The alga *Cephaleuros* (*virescens*) *mycoidea* Karst. attacks a wide range of plants in tropical and subtropical regions. The author describes how it occurs on twigs, leaves, and fruit of oranges under cultivation in the south of Florida. The illustrations show its distribution and manner of growth on the rind of an orange. A. G.

Panama Algæ.—FRANCIS DROUET ("Some Myxophycæ from the Canal Zone," *Bull. Torrey Bot. Club*, 1937, **64**, 599–604, 3 figs.). A list of nineteen Myxophycæ from the Panama Canal Zone received from various collectors. Most of the material comes from subaërial and aërial habitats, but some, collected on mica slips, comes from shallow water in Gatun Lake. Only two small papers had been published on the subject previously. An emended description of *Schizothrix violacea* Gardn. is included. A. G.

Plectonema.—OTTO JAAG ("Eine neue Blaualge, *Plectonema capitata*," *Ber. Schweiz. Bot. Ges.*, 1935, **44**, 437–42, 2 figs.). Description of a new species of *Plectonema*, found growing on a fallen tree in the spray of a waterfall near the Mittersee, Lunz, in Lower Austria. The structure of the filaments is figured and discussed. A. G.

Heterokontæ.—WILHELM VISCHER ("Über Heterokonten und Heterokonten-ähnliche Grünalgen," *Ber. Schweiz. Bot. Ges.*, 1936, **45**, 372–410, 17 figs.). The results of a study of the developmental history of certain Heterokontæ (*Bumilleriopsis*, *Heterothrix*, *Heterococcus*) and some other Chlorophytes (*Dictyococcus*, *Muriella*), which were maintained in pure cultures. Descriptions and figures are given of the following novelties: *Bumilleriopsis Peterseniana*, *Heterothrix debilis*, *Heterococcus caespitosus*. The life-history and ecology of the last-named species were very carefully studied and contrasted with those of *H. Chodati* (= *H. viridis* Chodat). Two genera of Chlorophyceæ which are liable to be mistaken for Heterokontæ were also cultivated, namely *Dictyococcus* Wille with zoospores or gametes, and *Muriella* Petersen with autospores. It is probable that to these belong a number of species at present described under other genera, for example, *Apatococcus*, *Botrydiopsis*, *Chlorellopsis*, *Chromochloris*, *Cryococcus*, *Palmellococcus*, *Pleurochloris*. Two new species are described—*Muriella aurantiaca* and *M. decolor*. A. G.

Ædocladium.—L. A. WHITFORD ("A New Green Alga: *Ædocladium Lewisii*," *Bull. Torrey Bot. Club*, 1938, **65**, 23–6, 1 pl.). Description and figures of a new species of *Ædocladium* collected at several places in North Carolina. Notes are added on the dividing cells and the formation of the cell wall. A. G.

Vaucheria in China.—LIANG CHING LI ("The Fresh-water Algae of China. III. A Monograph of the Algal Genus *Vaucheria* in China," *Bull. Fan Memorial Inst. of Biology*, 1936, **7**, Botany, 95–111, 2 pls.). A list of eleven species and one new variety of *Vaucheria* with figures and short diagnoses, literature, and distribution. A. G.

Vaucheria.—CLARENCE E. TAFT ("A New Species of *Vaucheria*," *Bull. Torrey Bot. Club*, 1937, **64**, 557, 1 fig.). Description and figures of *Vaucheria discoidea*, a new species from Oklahoma, characterized by short-stalked turbinate fertile branchlets bearing a verticil of six to sixteen oogonia and an apical hooked antheridium. A. G.

Caulerpa.—KIICHI MIYAKE and HIROSHI KUNIEDA ("On the Sexual Reproduction of *Caulerpa*. Preliminary Note," *Cytologia*, 1937, **8**, 205–7, 11 figs.). An account of the observations of the authors during the past ten years on the mode of reproduction of *Caulerpa brachypus* on the coast of Japan. Tiny hyaline dots appear on the green fronds, grow into papilliform gametangia, and in a few days discharge their contents—the gametes. A day previous to liberation some of the plants acquire a greenish yellow colour, the others remain unaltered. The former are female plants, the others are male. The gametes are subpyriform with two cilia inserted below the acute tip, the female containing a large green chloroplast and a red eye-spot near the blunt base. The female gamete is larger than the male, is slower in movement, and comes to rest sooner than the male. The process of conjugation is figured. The zygote is spherical and gradually enlarges, the chloroplasts multiplying by division to thirty or more. The further development has not been followed. A. G.

Scinaia.—F. BOERGESEN ("Two Species of *Scinaia* from South India," *Bot. Notiser*, 1938, 183–89, 3 figs.). A description of *Scinaia bengalica*, a new species from the coast of Madras, with figures of its habit and structure and notes on *S. carnosa* and two other India species. A. G.

Algal Galls.—E. CHEMIN ("Role des bactéries dans la formation des galls," *Ann. Sci. Nat. Bot.*, 1937, sér. 10, 19, 61–71, 3 figs., 1 pl.). Various excrescences on Floridæ have been described in the past; some of these have proved to be parasitic algæ, as *Harveyella* on *Rhodomela*; others are now known to be stages in the life history of the host-alga, as *Actinococcus* on *Gymnogongrus*; others, which are often seen on *Cystoclonium* and *Ahnfeltia* and less frequently on other genera, are galls. The nature of such galls, their structure, probable cause, and conducive environment, are discussed. The local hypertrophy of the algal tissue is due probably in all cases to the attack of bacteria lodged in the intercellular spaces. A. G.

Pelagophycus.—CHARLES C. HERBST and GEORGE R. JOHNSTONE ("Life-History of *Pelagophycus porra*," *Bot. Gazette*, 1937, 99, 339–54, 10 figs.). An account of the life-history of *Pelagophycus*, which like other genera of the Laminariales exhibits an alternation of generations, a massive macroscopic sporophyte alternating with a microscopic gametophytic generation. The spores from the sporophyte are morphologically homosporous but physiologically different, are non-motile and arise from unilocular sporangia. Some of these spores develop into microgametophytes, others into megagametophytes, both being of microscopic size. The germination of the spores and the development of the gametophytes was conducted in a culture cabinet under specially controlled illumination. Microgametophytes are smaller than the female plants and produce antheridia with single sperms, terminally or at the tips of lateral branches. No sperms were actually observed to leave the antheridia, but several were observed imbedded in the matrices of the eggs. The megagametophytes are composed of nine to fourteen cells, and are larger than the male plants and more branched; they produce a single oogonium at the tip of a branch; the egg is extruded and apparently soon becomes fertilized; a wall is formed, and the development of the sporophyte begins. The young sporophytes are monostromatic, cell division taking place in one plane only, the cells of the primary filament having divided longitudinally; but the basal cell elongates and after several weeks puts out rhizoids. A. G.

Indian Algæ.—F. BOERGESEN ("Contributions to a South Indian Marine Algal Flora. II," *J. Indian Bot. Soc.*, 1937, 16, 311–57, 20 figs.). A list of seven brown and fifty-eight red algæ collected by Prof. M. O. P. Iyengar on the coasts of Madras, with descriptions and figures of four new species of Rhodophyceæ, and critical and descriptive notes on several species which were confused or imperfectly known. A. G.

Chinese Algæ.—C. K. TSING ("On Marine Algæ new to China," *Bull. Fan Memorial Inst. of Biology*, 1936–37, 7, 169–96, 9 figs., 1 map; 231–55, 5 figs.). The number of marine algæ recorded for the vast coast of China is small, only about 280, and this is due to the enormous amount of fresh-water and mud which is brought down by the two great rivers, Yangtze-kiang and Huang-ho, and becomes spread far along the coast-line. But the islands which lie beyond the reach of the river water afford better conditions for algæ. The author has made several collecting trips in the past few years, and has begun a series of papers in which new algal records for China are given with descriptive notes, distribution, literature, and a number of structural figures. In the first two instalments are four Myxophyceæ, eight Chlorophyceæ, eleven Phæophyceæ, and nineteen Rhodophyceæ. A. G.

Fungi.

Oomycetous Parasites.—C. DRECHSLER ("Two Hyphomycetes Parasitic on Oospores of Root-rotting Oomycetes," *Phytopathology*, 1938, **28**, 81–103, 5 text-figs.). *Trinacrium subtile* was one of the Hyphomycetes found parasitizing species of *Pythium* which cause root-rot of various plants. This has triradiate and cruciform conidia. The other, with triseptate *Fusarium*-like conidia, is described as a new species, *Dactyella spermatophaga*. Cultural experiments were made. F. L. S.

Allomyces.—R. EMERSON ("A New Life-Cycle involving Cyst-Formation in *Allomyces*," *Mycologia*, 1938, **30**, 120–33, 11 text-figs.). Of thirty species of *Allomyces* collected from soil from different parts of the world the majority were found to have a life-cycle similar to that described by Kniep for *A. javanicus* and *A. arbuscula*, which exhibit an alternation of sporophyte and gametophyte generations. Zoospores from the resistant sporangia of four of the strains isolated, however, did not germinate directly to produce the gametophyte generation, but encysted for about a couple of hours. The cyst then formed an exit papilla and released usually four unciliate zoospores. These after swarming reproduce the parent plant. The zoospores from the resistant sporangia were generally biciliate, hence it is suggested that these are actually zygotes. The genus is tentatively subdivided into two subgenera: *Euallomyces* and *Cystogenes*. F. L. S.

Obelidium.—F. K. SPARROW ("The Morphology and Development of *Obelidium mucronatum*," *Mycologia*, 1938, **30**, 1–15, 44 text figs.). Since Nowakowski's description of *Obelidium mucronatum* in 1876 this fungus has remained practically unstudied until this present account, based on abundant material from the exuviae of various midges and caddisflies collected near Ann Arbor, Michigan, in June. The morphology and development of this Chytridiaceous fungus is given and reference is made to another species of the genus, *O. hamatum*, recently described by the author. F. L. S.

Zoopagaceæ.—C. DRECHSLER ("New Zoopagaceæ capturing and consuming Soil *Amæba*," *Mycologia*, 1938, **30**, 137–58, 4 text-figs.). An account of two species of *Zoopage* and one of each of *Acaulopage* and *Stylopage* described for the first time. They resemble each other in their vegetative and reproductive organs and are placed in the family Zoopagaceæ, which now contains thirty species, although it has not previously been defined owing to the author's wish for greater knowledge of facts and relationships. Good drawings are given of the four new species. F. L. S.

Myriangium.—J. H. MILLER ("Studies in the Development of two *Myriangium* Species and the Systematic Position of the Order Myriangiales," *Mycologia*, 1938, **30**, 158–82). *Myriangium Duriaei* Mont. & Berk. and *M. Curtisii* Mont. & Berk. were studied from serial sections. The fertile disc of the former is simple, consisting of the asci and ascogenous hyphæ from one archicarp, while in the latter it is compound. In a discussion of relationships of the family it is concluded that the Pseudosphæriales and Dothideales cannot have originated from the Myriangiales, because the interthecial tissue is ontogenetically different, and that the Myriangiales should be placed next to Plectascales and not with the Pyrenomycetes proper, as they do not produce perithecia. F. L. S.

Emericella.—H. P. CHOWDHURY and R. S. MATHUR ("On a New Species of *Emericella* found in Lucknow," *Ann. Myc.*, 1938, **36**, 61–4). The species previously known of *Emericella* are *E. erythrospora*, from rotting olives in Italy, and *E. varie-*

color, from S. India. Now another species, *E. medias*, also from India, is described. It is minute, reddish-brown, and turbinate, and occurs on rotting leaves, bark of *Eucalyptus*, and megasporophylls of *Cycas*. F. L. S.

Phæocryptopus.—F. PETRAK ("Beiträge zur Systematik und Phylogenie der Gattung *Phæocryptopus* Naumov.," *Ann. Myc.*, 1938, **36**, 9–27). A revision and emendation of the genus *Phæocryptopus*, which consequently now consists of three species. F. L. S.

Meliolineæ.—C. G. HANSFORD ("Contributions towards the Fungus Flora of Uganda. I. The *Meliolenæ* of Uganda," *J. Linn. Soc. London*, 1937, **51**, 265–85). This account of all the *Meliolineæ* so far collected and recorded for Uganda consists of sixty-eight species and varieties, of which twenty-nine species and six varieties of *Meliol* are described as new to science, as also are two species of *Amazonia*, one species and one variety of *Irenopsis*, and three species of *Irenina*. F. L. S.

Cordyceps.—E. B. MAINS ("A New Species of *Cordyceps* with Notes concerning other Species," *Mycologia*, 1937, **29**, 674–78, 2 figs.). An unusual *Cordyceps* was found in Nova Scotia, New York, and British Honduras, and named *C. viperina*. It is characterized by a cushion of fertile tissue which develops below and rather to one side of the clava and partly surrounds it, producing a one-sided habit. It somewhat resembles *Ophiocordyceps unilateralis*, but differs in being a true *Cordyceps* with filiform ascospores breaking into segments. Short notes are made on five other *Cordyceps*. F. L. S.

New Discomycete.—F. J. SEAVER ("Photographs and Descriptions of Cup-Fungi. XXVIII. A Proposed Genus," *Mycologia*, 1937, **29**, 678–81, 1 fig.). After critical study of *Peziza aurantiopsis* Ellis, which has characters resembling *Bulgaria*, *Urnulla*, and *Phillipsia*, it was decided to create a new genus, *Wolfina*, for it. F. L. S.

Pycnopeziza.—W. LAURENCE WHITE and H. H. WHETZEL ("Pleomorphic Life-Cycles in a New Genus of the Helotiaceæ," *Mycologia*, 1938, **30**, 187–204, 21 text-figs.). Two species of fungi which were collected for many years from decaying leaves, buds, and catkins in America were found to be closely related and to belong to a genus of Discomycete hitherto not described, *Pycnopeziza*, and exhibiting three kinds of fructification: apothecia, pycnidia, and spermogonia. *P. sympodialis*, the type species, is characterized by dark brown apothecia, at first pyriform, then splitting to form a stellate cup and by minute, globose spermogonia containing short cylindrical spermatia. The pycnidia are *Acarosporum sympodiale* Bubák and Vleugel. Although the genetic connection of the three spore forms is not doubted, only pycnidia have been produced in culture from ascospores. Spermogonia have not appeared. F. L. S.

Catinula.—J. W. GROVES ("The Perfect Stage of *Catinula turgida*," *Mycologia* 1938, **30**, 46–54, 8 text-figs.). *Catinula turgida*, commonly occurring on twigs of *Corylus*, was found associated with a small pale yellow *Pezicula*. Genetic connection between the two forms was established by cultures. The Discomycete is named *Pezicula corylina*. F. L. S.

Agaricus.—J. W. HOTSON and D. E. STUNTZ ("The Genus *Agaricus* in Western Washington," *Mycologia*, 1938, **30**, 204–35, 12 text-figs.). Twenty-four species of *Agaricus* (*Psalliota*) are described or recorded from western Washington and an artificial key for their identification is included. F. L. S.

Psalliota.—P. BAAR ("Un Genre Embrouillé en Mycologie Le Genre *Psalliota* Fr.," *Bull. Soc. Roy. Bot. Belg.*, 1937, **70**, 41–51). A revision of the genus *Psalliota* under the sections *Campestre*, in which the flesh tends to redden, and *Arvense*, where it tends to become yellow. F. L. S.

Psalliota.—J. SCHAEFFER ("Beitrag zur *Psalliota*-Forschung," *Ann. Myc.*, 1938, **36**, 64–83). A detailed descriptive account of the Genus *Psalliota*, together with a table showing the reactions of different species to sulphuric acid, potassium and sodium nitrates, and colourless aniline oil. F. L. S.

New Agarics.—A. H. SMITH ("New and Unusual Agarics from North America. I." *Mycologia*, 1938, **30**, 20–42, 4 text-figs.). Thirty-six species of Agarics are considered, of these two are described as new: *Hebeloma sporadicum* and *Omphalia orickiana*. Microscopic details are included in the descriptions. F. L. S.

Agarics.—J. RICK ("Agarici Riograndenses," *Lilloa*, (1937), **1**, 307–47). The first part of a paper describing agarics from Brazil; many are described for the first time. A list of spore measurements is given for the different species of *Lepiota*, under the headings: spores greater than 10μ in length, between 5 and 10μ and less than 5μ . F. L. S.

Agaric Synonymy.—M. JOSSERAND and A. H. SMITH ("Notes on the Synonymy of French and American Agarics. I," *Mycologia*, 1937, 717–25). After exchanging descriptions, photographs, and specimens the French and American authors propose the following names: *Collybia myriadophylla* (Peck) Sacc. for *C. lilacea* Quél., *Omphalia gracilis* Quél. for *Mycena immaculata* (Peck) Sacc., *Omphalia marginella* (Pers.) Joss. and Maire for *O. rugosodisca* Peck, *Panellus mitis* (Pers) Singer for *Panus bacillispora* Kauff., and *Pholiota albocrenulata* Peck for *P. fusca* Quél. F. L. S.

Fomes.—W. A. CAMPBELL ("The Cultural Characteristics of the Species of *Fomes*," *Bull. Torrey Bot. Club*, 1938, **65**, 31–70, 128 text-figs.). The purpose of this study was to find a practical system whereby fungi causing decay in timber might be identified from their cultural characters. Thirty-one species of *Fomes* were studied and their distinctive characters observed, in particular the following points being noted: reaction to medium, texture, and colour of mat; growth rate; odour; size; presence or absence of clamps; secondary spores; any supplementary structures; response to light and temperature. The addition of 5 p.c. gallic and tannic acids to malt agar was a reasonably good way of distinguishing between white-rot and brown-rot fungi. The cultures of the thirty-one species are described and a key to them is included. F. L. S.

Sinolloydia.—C. H. CHOW ("Notes on *Sinolloydia*, a Nomenclatural Change to the Fungus Genus *Lloydia*," *Bull. Fan Mem. Inst. Biol.*, 1936, **7**, 165–8). Owing to the name *Lloydia* already occurring in the Liliaceæ, this name for the phalloid genus described in 1935 is now changed to *Sinolloydia*. A note on the difference between *Lloydia* and *Lysurus* is added. F. L. S.

New Fungus.—J. N. COUCH ("A New Fungus intermediate between the Rusts and *Septobasidium*," *Mycologia*, 1937, **29**, 665–74, 30 text-figs.). *Uredinella coccidiophaga* is a species and genus of fungus described for the first time. The fungus is small and discoid, living on a scale insect into which it sends haustoria. It produces brown, uninucleate teleutospores which give rise to four-celled basidia, uninucleate at first. Later each basidial cell has two nuclei, one of which goes to

the basidiospore soon to be formed, while the other, together with cytoplasm, remains in the sterigma. Besides the teleutospores binucleate spores similar to them are formed, but each of these produces a long, curved binucleate spore. These are regarded as uredospore mother-cell and uredospore respectively. The resemblance to *Septobasidium* lies in the haustoria and in the presence of protoplasm in the sterigmata after spore discharge.

F. L. S.

New Rusts.—E. B. MAINS ("Two Unusual Rusts of Grasses," *Mycologia*, 1938, 30, 42–6, 1 text-fig.). *Angiopsora Zeae* is described for the first time. It occurred on maize in Guatemala and, as well as uredospores, it bore the characteristic catenulate telentospores of this genus. A new combination, *Phakopsora apoda*, is made for *Puccinia apoda*, described by Hariot and Patouillard, owing to the discovery of one-celled, irregularly arranged, and compressed teleutospores.

F. L. S.

Puccinia.—C. R. STILLINGER ("Distribution, Hosts, and Internal Telia of *Puccinia Parkeræ*," *Mycologia*, 1938, 30, 235–43, 2 text-figs.). Previously *Puccinia Parkeræ* Diet. and Holway was recorded only from the Oregon and Washington coastal region. Its distribution is now extended to eastern Washington, northern Idaho, and British Columbia, and it has been found on *Ribes bracteosum*, *R. sanguineum*, and *Grossularia divaricata*, as well as on *Ribes lacustre*. In the latter internal teleutosori were recorded.

F. L. S.

Cronartium Penetration.—R. R. HIRT ("Relation of Stomata to Infection of *Pinus Strobus* by *Cronartium ribicola*," *Phytopathology*, 1938, 28, 180–91, 2 figs.). Examination of a large number of needles inoculated with *Cronartium ribicola* showed that the germ tubes of the sporidia penetrated the epidermal cells directly. The arrangement, structure, and movement of stomata was studied in detail.

F. L. S.

Phomopsis.—J. A. MACDONALD and J. R. RUSSEL ("*Phomopsis scobina* (Cke.) v. Hoehn. and *Phomopsis controversa* (Sacc.) Trav. on Ash," *Tr. & Proc. Bot. Soc. Edinburgh*, 1937, 32, 341–53, 2 pls.). Cultures and infection tests of *Phomopsis scobina* and *P. controversa* from ash revealed such marked differences for the two fungi that the conclusion is reached that they must be regarded as separate species and not as forms of one species as has been suggested occasionally.

F. L. S.

Hercospora.—F. PETRAK ("Beiträge zur Kenntnis der Gattung *Hercospora* mit besonderer Berücksichtigung ihrer Typusart *Hercospora Tiliæ* (Pers.) Fr.," *Ann. Myc.*, 1938, 36, 44–61). Detailed descriptive and systematic notes on the genus *Hercospora* and on species which have been confused with its species, especially *Melanconis Desmazierii* n. sp. confused with *Hercospora Tiliæ*.

F. L. S.

Phymatotrichum.—G. M. WATKINS ("Histology of *Phymatotrichum* Root-rot of Field-grown Cotton," *Phytopathology*, 1938, 28, 195–202, 1 fig.). *Phymatotrichum omnivorum* forms wefts over the surface of the periderm, which in consequence begins to change in structure, colour, and thickness, suggesting chemical action from substances liberated by the hyphæ. Breaks in the periderm cell walls occur and the fungus enters the cell cavity. Penetration progresses through the periderm, phellem, phellogen, phloem, and cambium. When the xylem is reached the hyphæ pass from cell to cell, chiefly through the pits, as the lignin is not easily broken down by the fungus.

F. L. S.

Cactus Disease.—J. J. TAUBENHAUS and G. E. ALTSTATT ("A Decay of Ornamental Cacti caused by *Aspergillus alliaceus*," *Mycologia*, 1937, **29**, 681-6, 1 fig.). *Aspergillus alliaceus* was isolated from pad decay of several ornamental cacti in South-west Texas. Artificial inoculation reproduced the disease, but only when the fungus was introduced through needle pricks. This is apparently the first record of this fungus causing cactus disease in the United States. F. L. S.

Gardenia Canker.—H. N. HANSEN and J. T. BARRETT ("Gardenia Canker," *Mycologia*, 1938, **30**, 15-20, 1 text-fig.). A species of *Phomopsis*, *P. Gardeniae*, hitherto not described is recorded as causing a canker and gall disease of *Gardenia jasminoides*, the only host on which it has been found although geographically it appears to have a rather wide distribution. F. L. S.

Lichen Parasites.—A. MICHALSKI ("Grzyzoki Pasozytynicze Na Porostach. Die Flechten Parasiten," *Act. Soc. Bot. Poloniae*, 1937, **14**, 45-9). A diagnostic account in Polish of *Abrothallus Parmeliarum* Nyl., *Scutula epiblastematica* Rehm, *Staganopsis Peltigeræ* Karst., *Phyllosticta Peltigeræ* Karst., and *Illosporium carneum* Fr. F. L. S.

Mint Anthracnose.—R. C. BAINES ("Mint Anthracnose," *Phytopathology*, 1938, **28**, 103-14, 4 text-figs.). A species of *Sphaceloma* is the fungus causing defoliation and stunting of several species of mint. Cultures of the fungus were isolated from black peppermint leaves and Scotch spearmint stem. Typical infection resulted from artificial inoculation. Morphological and physiological details of the fungus are given. F. L. S.

Opuntia Disease.—B. O. DODGE ("A Further Study of the Dry-Rot Disease of *Opuntia*," *Mycologia*, 1938, **30**, 82-97, 5 text-figs.). The various fungi causing disease of *Opuntia* are studied and analysed. Their life-histories are not yet disentangled and it is hoped that mycologists living in *Opuntia* districts may take up the investigation of the problem. F. L. S.

Opuntia Fungus.—B. O. DODGE ("The Perithecial Cavity Formation in a *Leptosphaeria* on *Opuntia*," *Mycologia*, 1937, **29**, 707-17, 2 figs.). A species of *Leptosphaeria* named *L. Opuntiae* sp. nov. was studied from sections made from herbarium material. The perithecial cavity was found to arise through the differential growth of the peripheral tissues, forming the wall, and the central cells which elongate by addition of intercalary cells. Ascogenous tissue arises from the base and grows up between the disorganizing central hyphae. The cavity formation apparently is very similar to that in *Sporormia leporina*. F. L. S.

Pimento Rust.—J. D. MACLACHLAN ("A Rust of the Pimento Tree in Jamaica, B.W.I.," *Phytopathology*, 1938, **28**, 157-70, 3 figs.). *Puccinia psidii* Wint. was found to be the organism causing a serious new disease of *Pimento officinalis*. The paper reports work on the biology of the fungus, and the factors affecting incidence of the disease, and discusses methods of control. F. L. S.

Raspberry Disease.—J. M. WATERSTON ("Note on the Association of a Species of *Phytophthora* with a 'Die-back' Disease of the Raspberry," *Tr. & Proc. Bot. Soc. Edinburgh*, 1937, **32**, 251-60, 2 pls., 2 text-figs.). A species of *Phytophthora* belonging to the *cactorum-omnivora* group is described from a die-back disease of the Lloyd George Raspberry. The fungus appears to be widely distributed in Britain, but only becomes parasitic when some predisposing factor, such as excessive moisture, is present. Definite proof of pathogenicity was not obtained. F. L. S.

Rose Canker.—A. E. JENKINS (" *Coryneum microstictum* on Rose from Oregon," *Mycologia*, 1937, **29**, 725–32, 2 figs.). An account of cultures, with microscopical details, of *Coryneum microstictum* isolated from cankers from Oregon, Eastern U.S.A., Canada, and England and of *C. Beyerinckii* from Oregon and Europe.

F. L. S.

Sycamore Disease.—F. A. WOLF (" Life-Histories of Two Leaf-inhabiting Fungi on Sycamore," *Mycologia*, 1938, **30**, 54–64, 14 text-figs.). Two fungi, *Cercospora platinifolia* and *Stigmata Platanis*, which cause leaf blight of sycamore were found to possess perithecial stages. The perithecia begin development in the autumn on fallen leaves. The perfect stage of *Cercospora platinifolia* was found to be *Mycospharella platinifolia* Cooke, while that of *Stigmata Platanis* is described for the first time and named *Mycospharella Stigmata-Platanis*.

F. L. S.

Hawaiian Discomycetes.—E. K. CASH (" New Records of Hawaiian Discomycetes," *Mycologia*, 1938, **30**, 97–108, 6 text-figs.). Thirty-five species of Discomycetes from the Hawaiian Islands are considered, only one of which has previously been recorded from this district. Six species are described as new to science.

F. L. S.

Venezuelan Fungi.—D. H. LINDNER (" New Venezuelan Fungi Imperfecti," *Mycologia*, 1937, **29**, 656–65, 6 text-figs.). An account of five species new to science.

F. L. S.

Sex.—R. VANDENDRIES (" Les Modalités Sexuelles des Basidiomycètes," *Bull. Soc. Roy. Bot. Belg.*, 1937, **70**, 66–86). A general account of the various sexual phenomena met with in Basidiomycetes, details to be dealt with in a subsequent paper. Here are discussed haploidy, diploidy, parthenogenesis, homothallism with and without clamp formations, bi- and tetra-polarity, fertility, sterility, and by hybridization.

F. L. S.

Mycetozoa.

Blastocystis.—MOMČILO IVANIČ (" Beiträge zur Kenntnis eines im Enddarmes des grünen Wasserfrosches lebenden Pilzes *Blastocystis Ranarum* spec. nov.," *La Cellule*, 1937, **46**, 159–79, 1 pl., 29 figs.). A hitherto undescribed species of *Blastocystis*, *B. ranarum*, is recorded from the rectum of the frog, *Rana esculenta*. Its life-history and cytology were studied and it is regarded as belonging to the Mycetozoa.

F. L. S.

Chinese Species.—C. H. CHOW (" Notes on Myxomycetes from North China," *Bull. Fan Mem. Inst. Biol. Botany*, 1937, **7**, 257–81). The specimens described were collected chiefly in Southern Chachar and a few in Tung-ling and Peiping. They belong to seventeen genera, of which *Leocarpus*, *Limnobladia* and *Enteridium* are recorded for the first time from China. In all, fifteen new records of species and varieties are reported in this account of thirty-three species.

F. L. S.

Cellulose.—A. NEDECZKY (" Występowanie Błonnika u Śluzowców (Über das Vorkommen der Zellulose bei Myxomyceten)," *Act. Soc. Bot. Poloniae*, 1937, **14**, 68–87). Cellulose occurred in all the forty species tested; of these nine had previously been recorded as possessing cellulose, in three it had been stated to be absent, and in the remaining twenty-eight it is recorded for the first time. The material was collected in beech forests of the Carpathians; *Arcyria stipitata*, incidentally, is reported for the first time for Poland. Cellulose was found in the spore wall,

peridium wall, and in the wall of the æthelium. The capillitium showed no cellulose reaction, but on the other hand it occurred in pseudo capillitia, indicating a diverse origin.
F. L. S.

Lichens.

Teloschistaceæ of Central Europe.—J. HILLMANN ("Teloschistaceæ," *Rabenhorst's Krypt.-Fl. Deutschl., Oesterr. u. d. Schweiz*, 1935, 9, 6. Abt., Lief. 1, 1-36, 4 figs.). This contribution deals with the genera *Xanthoria* and *Teloschistes*. Five species of the former and one of the latter occur in Central Europe. Keys to the genera, species, varieties, and forms are given; in respect of the well-known *Xanthoria parietina* in particular the key to the numerous and often imperfectly understood subdivisions will be welcome to lichenologists.
I. M. L.

Physciaceæ of Central Europe.—B. LYNGE ("Physciaceæ," *Rabenhorst's Krypt.-Fl. Deutschl., Oesterr. u. d. Schweiz*, 1935, 9, 6. Abt., Lief. 1, 37-188, 10 figs., 12 pls.). The author has undertaken a completely new monographic study of the Central European species of *Anaptychia* and *Physcia*, and has subjected the results of his former treatment of the Norwegian Physciaceæ (1916) to a thorough re-examination. The result now offered is a critical and useful treatment of the species involved, particularly in that many of the descriptions are based on the actual type-specimens of Acharius and Nylander. The genus *Physcia* is divided into two subgenera, *Macrosperma* Vain. and *Brachysperma* (Vain.) emend. Lynge, depending on the length of the pycnoconidia. The latter subgenus is further sub-divided into the sections *Albida*, *Tenella*, *Stellaris*, *Astroidea*, *Cæsia*, *Tribacia*, *Obscura*, and *Pulverulenta*. Keys are given to genera and species, and the usefulness of these for purposes of identification is increased by the very fine habit-photographs constituting the plates. A new variety of *P. sciastra* and a new form of *P. grisea* are published, and a number of new combinations are made.
I. M. L.

Parmeliaceæ of Central Europe.—J. HILLMANN ("Parmeliaceæ," *Rabenhorst's Krypt.-Fl. Deutschl., Oesterr. u. d. Schweiz*, 1936, 9, 5. Abt., Teil 3, Lief. 1-2, 1-309, 1-10, 26 figs., 2 pl.). The family Parmeliaceæ is represented in Central Europe by the genera *Candelaria*, *Parmeliopsis*, *Parmelia*, and *Cetraria*, which are dealt with in these two parts. Keys to genera, species, and in some cases varieties and forms are included. *Parmeliopsis* is divided into two new sections *Curvoconidia* Hillm. and *Rectoconidia* Hillm., depending on the length and form of the pycnoconidia. A new subsection of the *Tubulosæ*-section of *Parmelia*, subsect. *Soraliferæ* Hillm., and a new section *Teretiusculæ* of the subgenus *Euparmelia*, are set up. In the treatment of the genus *Parmelia* a large number of recently diagnosed European species, varieties, and forms are not included, on the grounds that they are based on fluctuating and non-systematic characters. The author's attitude in the matter of the evaluation of chemical criteria is one of mediation between the two extremes. One new variety and nine new forms of *Parmelia* are described. The genus *Cetraria* contains *Platysma* and *Eucetraria* as sections, the former subdivided into the three new subsections *Glaucescentes*, *Flavescents*, and *Fuscescentes*, the latter into two new subdivisions *Flavidæ* and *Obscuriores*. Six varieties of *Cetraria* are described as new.
I. M. L.

Coniocarpineæ of Central Europe.—K. VON KEISSLER ("Coniocarpineæ," *Rabenhorst's Krypt.-Fl. Deutschl., Oesterr. u. d. Schweiz*, 1937, 9, 1. Abt., Teil 2, Lief. 4, 481-640, 38 figs., and Lief. 5, 641-846, 30 figs.). In the first twenty-five pages of part 4 the treatment of the Pyrenocarpeæ, continued from the previous part, is concluded with genus *Mycoporellum*, and a list of genera and species to be

excluded as fungi. The Coniocarpæ comprise the families Caliciaceæ, Cypheliaceæ, and Sphærophoraceæ. Keys to the genera and species are given, and the text-figures, illustrating for the most part the habit of the fruit-bodies, assist materially in identification. A number of new combinations are made, but no new systematic entities are published. I. M. L.

The Genera *Enterographa* Fée and *Sclerophyton* Eschw.—K. REDINGER ("Restitution und kritische Revision der Flechtengattungen *Enterographa* Fée und *Sclerophyton* Eschw.," *Fedde, Repertorium*, 1938, 43, 49–77, 1 pl.). On account of the absence of a true stroma, the genus *Enterographa*, for many years regarded as a section of *Chiodecton*, is removed from the latter and reinstated as a proper genus having its closest affinities with *Opegrapha*. The dark-spored counterpart of *Enterographa*, *Sclerophyton*, also possesses no stroma, and for the same reason is transferred from Chiodectonaceæ to Graphidaceæ. It is possible that Müller-Argau's genus *Gymnographa* is identical with *Sclerophyton*, but without having seen the type-specimen of the former the author is unable to prove this. The species of *Enterographa* and *Sclerophyton* are treated monographically, keys to the species being appended. Twenty-nine species of *Enterographa* and three of *Sclerophyton* are recognized. One species of *Enterographa*, *E. neozelandica*, three varieties, and two forms are new to science, and numerous new combinations are made. I. M. L.

The Apothecia of *Siphula*.—V. RÄSÄNEN ("Das Rätsel der Flechtengattung *Siphula* Fr. gelöst. *Siphula patagonica* Vain. mit Apothecien und Sporen gefunden," *Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo*, 1937, 8, 3–8, 1 fig.). A specimen of *Siphula patagonica* Vain. from Chile, sent to the author by R. P. A. Hollermayer, was found to be provided with a well-developed apothecium containing asci and spores. Previously the species of the genus *Siphula* had been known only in the sterile condition. The apothecium in the present instance was apparently lecanorine and was concolorous with the thallus; the possibility of it belonging to a lichen-parasite is therefore excluded with certainty. The thalline margin does not, however, include gonidia; hypothecium and hymenium are colourless, the paraphyses being thin, simple and gelatinized. Spores are four to six in the ascus, broadly fusiform, four-celled, colourless, and thin-walled, $16\text{--}20\ \mu \times 6\text{--}7\ \mu$. From a consideration of the apothecial structure Räsänen suggests that the genus *Siphula* should be included either in the Usneaceæ or in a family of its own, Siphulaceæ, according to the amount of importance attributed to the peculiarity of the gonidia-free pseudothalline margin. I. M. L.

Chemistry of Irish Lichens.—G. KENNEDY, J. BREEN, J. KEANE, and T. J. NOLAN ("The Chemical Constituents of Lichens found in Ireland—*Lecanora sordida* Th. Fr.," *Sci. Proc. Roy. Dublin Soc.*, 1937, 21, No. 49, 557–66, 1 pl.). Irish material of *Lecanora sordida* was found to contain roccellic acid (4.1 p.c.), atranorin and chloratranorin (together 0.7 p.c.), and small quantities of mannitol and a substance which may be thiophanic acid, and for which the formula $\text{C}_{24}\text{H}_{20}\text{O}_9\text{Cl}_2$ is suggested.

J. BREEN, J. KEANE, and T. J. NOLAN ("The Chemical Constituents of Lichens found in Ireland—*Pertusaria concreta* Nyl., form *Westringii* Nyl.," *op. cit.*, 1937, 21, No. 52, 587–92, 1 pl.). The principal chemical constituent of Irish material of *Pertusaria concreta* f. *Westringii* was found to be norstictic acid, $\text{C}_{18}\text{H}_{12}\text{O}_9$. Two other substances also occur in minor amount, namely mannitol and a chlorine-containing substance with the formula $\text{C}_{14}\text{H}_7\text{O}_5\text{Cl}_3$, to which the authors assign the name concretin.

MARGARET MOHAN, J. KEANE, and T. J. NOLAN ("The Chemical Constituents of Lichens found in Ireland—*Parmelia conspersa* Ach.," *op. cit.*, 1937, **21**, No. 53, 593–4). *Parmelia conspersa* had previously been found by Zopf and others to contain salazic acid in the medulla. Irish material of this species proved on analysis, however, to contain stictic acid instead of salazic acid. I. M. L.

Contributions to the Lichenology of Java.—P. GROENHART ("Beiträge zur Kenntnis der Javanischen Flechten. I–III," *Nederlandsch Kruidkundig Archief*, 1936, **46**, 690–784, 7 figs.). The first part includes a list of literature in which lichens from Java are mentioned, followed by a list of all lichens recorded from Java, arranged in systematic order; 475 species in all are enumerated. Then follows a list of the Javan lichens collected by Zollinger, and an index to all genera and species mentioned. In the second part of this paper a new lichen, *Sporopodium* (Sect. *Gyalectidium*) *Oudemansii* Groenh., occurring in Java on coffee-leaves, is described. The third part includes the results of the author's investigation of *Byssophytum Hollei* Mtge and v. d. B., based on the type-specimen in herb. Leiden. It was found that the structures which Montagne and van den Bosch described as apothecia are in reality soralia. A new species of *Byssophytum*, *B. album* Groenh., is also described, in which peculiarly flattened discoid soredia, named by the author macrosoredia, are formed in series which sometimes cohere, producing the appearance of piles of coins. It is possible that these highly organized soralia represent transformed apothecia. The emended genus *Byssophytum* is divided into two sections, *Ecapitulatæ* and *Capitulatæ*, derived from the characters of the soralia. I. M. L.

Lichens from Argentina.—V. KÖFARAGÓ-GYELNIK ("Lichenes Argentinienses a Professore C. C. Hosseus collecti. Continuatio prima," *Fedde, Repertorium*, 1938, **43**, 83–7). A continuation of the author's enumeration of Argentine lichens collected by Hosseus, the first part of the treatment having appeared previously in the same journal (1934, **33**, 302–9). Twenty-nine species are enumerated, of which four (three of *Parmelia* and one of *Bryopogon*) are new to science; a new variety of *Parmelia rugulosa* and a new form of *Teloschistes exilis* are also described for the first time. I. M. L.

Lichens from Chile.—V. RÄSÄNEN ("Collationes ad Lichenologiam chilensem pertinentes," *Revista Universitaria (Universidad Catolica de Chile)*, 1936, **21**, 137–48). Systematic treatment of a collection of lichens from southern Central Chile, sent to the author by Messrs. Gualterio Looser and Hugo Gunckel. Ninety-four lichens, mostly fruticulose and foliaceous, are enumerated, among which are eight new species (in *Usnea*, *Parmelia*, *Nephromium*, and *Bacidia*), seven new varieties (in *Usnea*, *Parmelia*, and *Catillaria*), and three new forms (in *Xanthoria*, *Cyanisticta*, and *Cladonia*). Some of the records are interesting from a geobotanical standpoint.

("Liquenes chilenos coleccionados por el R. P. Atanasio Hollermayer en 1927–1936 (1)," *op. cit.*, 1937, **22**, 195–211). An enumeration of ninety-five lichens from various regions in Chile collected by R. P. A. Hollermayer. It includes descriptions of six new species (in *Parmelia*, *Usnea*, *Teloschistes* (here erroneously spelt *Theloschistes*), *Leciophysma*, and *Lecidea*) and fourteen new varieties (in *Gyrophora*, *Parmelia*, *Stereocaulon*, *Opisteria*, *Stictina*, *Cyanisticta*, *Pseudocyphellaria*, *Bæomyces*, and *Cladonia*). I. M. L.

NOTICES OF NEW BOOKS.

Microscope Record.—No. 43. January, 1938. 23 pp. No. 44. May, 1938. 23 pp. Illustrated. Published by W. Watson & Sons, Ltd., 313, High Holborn, W.C.1. *Gratis*.

Transactions of the Bose Research Institute, Calcutta : Biological and Physical Researches.—Vol. XI. 1935–36. Edited by Sir J. C. BOSE. vi + 190 pp. 61 text-figs. Published by Longmans, Green & Co., Ltd. 39, Paternoster Row, E.C.4. Price 18s. net.

Faune de France. 33. Tuniciers (Fascicule 2 : Appendiculaires et Thaliacés.) 1938. By Dr. Hervé Harant and Dr. Paulette Vernières. 59 pp., 64 text-figs. Published by MM. Paul Lechevalier et Fils, 12, Rue de Rournon (VI^e), Paris. Price 40 Fr.

Histological Technique for Normal Tissues, Morbid Changes and the Identification of Parasites.—By H. M. CARLETON and E. H. LEACH, in collaboration with F. HAYNES. 2nd Edition. 1938. xvi + 383 pp., 18 text-figs. Humphrey Milford, Oxford University Press, London, New York, and Toronto. Price 17s. 6d. net.

The appearance of a second edition of this excellent work has provided an opportunity for careful revision. A departure from current practice has been made by inserting in the earlier part of the book a chapter on the conception of cells and tissues as complex colloidal entities, all too easily altered by the treatment to which they are subjected. While it is most salutary to be reminded of the various artefacts produced by a particular process, it may be questioned whether this chapter is necessary in what has become an essential book for the laboratory bench rather than the study. The particular aim has been first to give in detail type methods for fixation, embedding, section-cutting and staining; next to provide workers with accessory and special methods; and finally to set out methods for the identification of morbid changes and parasites of various sorts in tissues. The first two objects have been very fully attained. The third cannot be so highly commended since none of the particular methods adopted for the staining of virus inclusions and virus elementary bodies is mentioned. No reference, for instance, can be found to Laidlaw's stain for virus inclusions, Castaneda's stain for rickettsia and virus bodies, or Victoria blue and the various methods of mordanting essential, with certain techniques, before staining virus bodies. A method for demonstrating Negri bodies would probably have been of much greater value than a section dealing with the staining of such uncommon parasites as coccidia. Some mention in a future edition might also be made of fluorescence microscopy and the use of such dyes as primulin.

G. M. F.

Laboratory Outline in Filterable Viruses.—By ROSCOE R. HYDE and RAYMOND E. GARDNER. 1937. x + 85 pp. Published by the Macmillan Company, New York. Price 7s. 6d. net.

This small book consists of two courses of study given in the School of Hygiene and Public Health at the Johns Hopkins University, Baltimore, to graduate students. Part I is planned to give the student a first-hand knowledge of the nature and behaviour of a number of representative viruses, while Part II aims at giving a more comprehensive account of the pathology of a selected group of virus diseases illustrating the change from necrosis to hyperplasia. Each part is divided into a series which requires the presence of a competent instructor. Filtration, the behaviour of bacteriophage and certain selected viruses are described in Part I, while in Part II the histopathology of these same viruses is more fully discussed, with special reference to virus inclusions. No very clear distinction is made between inclusions made up of elementary bodies and those which do not appear to be made up of virus particles. Castaneda's stain is not mentioned, although it is of great value for demonstrating the difference between elementary bodies and cell granules. It is perhaps optimistic to say that "collodion membranes are easily prepared from nitrocellulose dissolved in glacial acetic acid," while many of the suggested exercises involve the use of living animals which cannot be used for such purposes in Great Britain.

G. M. F.

The Structure and Development of the Fungi.—By H. C. I. GWYNNE-VAUGHAN and B. BARNES. 1937. 2nd Edition. 449 pp., 309 text-figs. Published by Cambridge University Press, London, N.W.1. Price 18s. net.

This useful introduction to the Fungi has been completely revised; twenty-four new figures have been added and the bibliography of papers cited is extended from 27 to 40 pages. In the decade since the first edition appeared the advances have been numerous and are here incorporated. Further investigations of the life-histories of the Ascomycetes appear to have resolved the previous contradictions. Even in the same organism there may be two nuclear fusions, producing a tetraploid condition followed by two reductions; or some nuclei may only fuse in the ascus, in which case there is but one reduction to the haploid condition in the ascospores.

The discovery of heterothallism in the rusts has explained the function of the obscure pycnospores and marks the most important recent advance in our knowledge of the life-cycles in the Fungi. It is not surprising that there are indications of heterothallism even in *Phytophthora*.

As an introduction to the morphology and cytology of fungi, this book will have increased usefulness both for the undergraduate student and for those taking up research.

R. R. G.

The Microscope: Theory and Practice.—By CONRAD BECK. 1938. 264 pp., 217 text-figs. Published by R. & J. Beck, Ltd., 69, Mortimer Street, W.1. Price 7s. 6d. net.

In 1921 Mr. Beck published what he described as a simple handbook to the use of the microscope, and this was followed in 1924 by a more advanced work which supplemented the earlier book. Either could be read independently, although there was an expressed intention that the later one should be regarded as supplementary. The present volume is in reality a new edition of both these works,

and in it the author has succeeded in reducing the amount of letterpress and yet has produced a treatise which is equally informative. From the point of view of the general reader there is one obvious limitation. The book is published by Messrs. R. & J. Beck, Ltd., the well-known microscope makers of which Mr. Conrad Beck is the respected head. It follows, therefore, that the microscopes and accessory apparatus described are almost exclusively the productions of that firm. This might easily have led to obvious advertisement, but there is no such suggestion. The scientific principles and practice of microscopy are the subjects dealt with, and it would be difficult to find any other book in which lucidity of exposition and clearness of description are so aptly combined. Descriptions of microscopes and accessories are included, but these are used to illustrate certain types and examples.

The introductory chapter provides an account of the essentials of a microscope mainly on the optical side. Chapter II provides an excellent guide to the geometric optics of the microscope. The author in his preface suggests that this chapter, together with others which he specifies, are not essential for a working understanding of the subject of practical microscopy. This is certainly true, and yet few who take the trouble to read this chapter with care will fail to benefit thereby. Chapter III, on aperture and resolution, is perhaps the most informative portion of the book; it certainly must take precedence because it indicates so clearly the essentials of microscopical practice. Chapter IV, on the photometry of the microscope, deals with a portion of the subject that the author has investigated himself; it is in large part a description of experiments, with deductions therefrom, which a serious student of microscope manipulation would wish to repeat. Chapter V is essentially practical, the instructions on technical procedure are lucid and informative. The same may be said in reference to Chapter VII; although the testing of microscope objectives is a difficult subject, it is doubtful whether anyone can carry out such tests satisfactorily without considerable experience. A clear account of the application of polarized light occupies the concluding chapter. There is little to be said in the way of criticism. A confusing mistake for the uninitiated is in the table on p. 98. Two objectives are mentioned as 38 mm., whereas the numerical aperture suggests that 3 mm. is intended. Occasionally, too, there are verbal lapses from lucidity; but the meaning becomes clear with a little thought and in no case is there doubt as to what the writer wishes to convey. On p. 169, for instance, the first paragraph refers to the "visual intensity of light" whereas probably what is meant is "visual sensitivity to light." The book explains those things a microscopist must know if he is to make good use of his apparatus, no matter how simple it may be. The author's eminence in the optical field is beyond dispute and his sympathetic understanding of technical difficulties confronting the practical worker comes to the surface in many passages in the book. What amateur or expert is there, for instance, who, like the author (p. 22), has not on some occasion experienced difficulty in focusing a section, and then has discovered that the slide has been placed on the stage with the coverslip downwards? The author of the book is human after all.

Perhaps in conclusion a personal note may be allowed. Mr. Beck was on the Council of the Royal Microscopical Society when the reviewer was received into the Society as a Fellow. This was many years ago. It follows, therefore, that his record is a long as well as an honourable one. Perhaps it is permissible to offer sincere congratulations to him on his ability still to produce a book that may be read with interest and appreciation by microscopists of any age. May he be spared to write still further editions.

J. E. B.

Australian Antarctic Expedition, 1911-1914. Scientific Reports, Series C—Zoology and Botany. Vol. i, part 2: FORAMINIFERA. F. CHAPMAN and W. J. PARR. Sydney, 1937, 1-190, pls. 7-10, various tables. Price £1 2s. 6d. net.

The joint authors, both Fellows of this Society, are to be congratulated on the eventual publication of this long expected report, the manuscript of which was completed as long ago as April, 1931. The delay has not only robbed the authors of priority in the case of several species but has also resulted in the use of a system of classification not altogether in agreement with their later views, as published in 1936. Moreover, it makes the task of the reviewer more difficult, inasmuch as the *Terra Nova* Antarctic report published in 1922 represents the base line for their comments, as the latest publication during the preparation of this report. References to the later discoveries of the *Gauss* and *Discovery* expeditions are rarely introduced except in the case of new species.

More than 100 samples containing Foraminifera were examined, from an enormous area roughly extending between 90°-164° E. and 42°-67° S. The material, which apparently consisted of soundings only, represents a variety of faunal conditions ranging between the subtropical and temperate seas of Australia, Tasmania, and New Zealand, the deep water of the Southern Ocean and the extreme cold of the Antarctic coast. The faunas are therefore very similar to those encountered by the *Terra Nova* expedition, which covered much the same ground, though the Antarctic area of the *Terra Nova* lies well to the east of the area explored by the *Aurora*.

Stations scattered over such an extensive area can hardly be visualized without an explanatory chart, but none is included in the report. No doubt charts have been published in other reports of the Expedition, but how many of those interested in the Foraminifera will have access to them or even to an atlas showing the Antarctic coastlines? Expense may have been the excluding factor, but this reviewer at least would have preferred a chart to the exhaustive tables of regional distribution, which must have entailed great labour in their preparation and have been very expensive to print. Not many people will have patience to examine four separate double-page tables in succession in order to trace the regional distribution of a species, especially as the records of stations and frequencies are summarized under each species in the general report.

The authors devote little space to summarizing their conclusions, confining their remarks to a couple of paragraphs. In the first they contrast the differences between the majority of the Antarctic species and those from Australian and New Zealand Tertiary and Quaternary deposits; this is attributed to the fact that the fossil deposits were laid down in temperate or subtropical seas. The second paragraph emphasizes the fact that a small proportion of species is common to Antarctic shallow waters and to the same Tertiary deposits, which is regarded as evidence that there are coastal areas now submerged which may have connected Antarctica with lower latitudes in the Southern Hemisphere.

The revision of a manuscript during suspended publication is no easy matter, but in view of the fact that their report is the last in the field it would have added greatly to its value if the authors had summarized their discoveries in an appendix and compared them with the reports of other Expeditions. What we really want to know is, which species are truly circumpolar and which are confined to particular areas? There is some evidence to show the existence of two distinct Antarctic marine faunas, which may be conveniently distinguished by the names of two Expeditions, *Terra Nova* and *Gauss*. One line of separation appears to lie in

the Graham Land area, from which point the *Terra Nova* fauna extends westwards circumpolar to a still unknown point west of the Ross Sea. Adelie Land, covered by the *Aurora* report, lies west of the Ross Sea in this hitherto unknown area, and the authors' lists have a definite similarity to those of *Terra Nova*. But they are also definitely different from the *Gauss* fauna taken off the coast of Kaiser Wilhelm's Land, which lies at no great distance to the west of Adelie Land; and making all allowance for the greater depth and distance off shore of the *Gauss* collections, it seems clear that the eastern line of separation of the two faunas lies somewhere between Adelie Land and Kaiser Wilhelm's Land.

The report deals with 342 species and varieties, of which twenty-eight are described as new. Many of the species first described in the *Terra Nova* report are in the list, including *Dendronina arborescens* H-A. and E. It is rather noteworthy that only one species of *Miliammina*, the type *M. arenacea* (Chapman), is recorded. Many of the species suspected of a circumpolar distribution appear, but some, including *Vanhoeffenella* and *Delosina*, were not found.

The illustrations by the senior author are hardly adequate for a report of this magnitude, several of the new species being shown in one aspect only. It would have been advisable to show new species in all aspects, even at the expense of other figures of species already illustrated adequately in other reports.

A few errors have survived the proofs as usual. In the list of new species on p. 6, *Ceratobulimina tenuis* occurs twice and *Recurvoides contortus* Earland is listed. This was one of the new species first found by the authors, but described elsewhere during suspended publication of their report. In No. 59 *entosolenian* for *ectosolenian* and in No. 221 *Atlantic* for *Antarctic* are self-evident. A whole section of the index has somehow dropped out of the type, involving all names between *botelliformis* and *dextrospiralis*, and a few other omissions have been noticed. Apart from these trifles the report as a whole is admirably produced.

A. E.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, B.M.A. HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, MARCH 16TH, 1938, AT 5.30 P.M., MR. J. E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Robert Ross, B.A.	London.
C. S. Todd.	Camberley.

Nomination Certificates in favour of the following candidates were read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

As Honorary Fellow :—

J. A. Cushman, Sc.D.	Sharon, Mass.
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As Ordinary Fellows :—

Christopher D. Lee.	Colchester.
B. Stracey, M.B., Ch.B.	Diemtigen, Switzerland.

Deaths.—The President announced the regrettable loss to the Society, by death, of the following Fellows :—

A. Rosenberg.	Elected 1924.
E. Wade Wilton.	„ 1911.

Donation was reported from :—

Dr. Miles Johnston (per Dr. J. A. Murray)—

A solar microscope with accessories in case, by Gilbert, London. c. 1800.

A vote of thanks was accorded to the donor.

Papers.—The following communications were read and discussed :—

Dr. W. J. Purdy, F.R.M.S.—

“ Tumour Structure and Tumour Problems.”
(Illustrated by micro-projection.)

Mr. N. Ingram Hendey, F.L.S., F.R.M.S.—

“A Technique for Cleaning Diatoms.”

Votes of thanks were accorded to the authors of the foregoing communications.

Announcement.—The President made the following announcement :—

The Biological Section will meet in the Pillar Room on Wednesday, April 6th, 1938.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, APRIL 20TH, 1938, AT 5.30 P.M., DR. G. M. FINDLAY, *C.B.E.*, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

New Fellows.—The following candidates were balloted for and duly elected to the Fellowship of the Society :—

As Honorary Fellow :—

J. A. Cushman, Sc.D.

Sharon, Mass.

As Ordinary Fellows :—

Christopher D. Lee.

Colchester.

Bernard Stracey, M.B., Ch.B.

Diemtigen, Switzerland.

Nomination Certificates in favour of the following candidates were read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

William Alves.

Southern Rhodesia.

James Richardson.

Glasgow.

Donation was reported from :—

Oxford University Press (Sir Humphrey Milford)—

“Histological Technique.” By H. M. Carleton. Second Edition.

A vote of thanks was accorded to the donor.

Papers.—The following communications were read and discussed :—

Prof. R. Ruggles Gates, F.R.S., F.R.M.S.—

“The Structure of the Chromosome.”

Dr. Miles Johnston—

“Some Methods of Preparing Fish Otoliths for Examination.”

(Communicated by Dr. J. A. Murray, F.R.S., F.R.M.S.)

Votes of thanks were accorded to the authors of the foregoing communications and to Dr. Murray for communicating the latter.

Announcement.—The Secretary made the following announcement :—

The Biological Section will meet in the Pillar Room on Wednesday, 4th May, 1938.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, MAY 18TH, 1938, AT 5.30 P.M., MR. J. E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

William Alves.	Southern Rhodesia.
James Richardson.	Glasgow.

Balance Sheet.—The President called upon the Treasurer, Mr. C. F. Hill, who presented his Financial Report and Balance Sheet for the year ended December 31st, 1937.

TREASURER'S REPORT AND BALANCE SHEET FOR THE YEAR ENDED 31st DECEMBER, 1937.

In presenting the audited accounts for the year 1937, I am glad to report that despite the diminished revenue from Fellowship subscriptions, which amounts to some £40 less than in the preceding year, the aggregate adverse balance brought forward has been appreciably reduced.

One Life Composition Fee has been received during the year and has been carried to Capital Account.

All items of expenditure show a reduction, and the net expenses in respect of the Journal are considerably less due largely to an increase in receipts from sales which amount to approximately £460, being some £45 higher than in the previous year, and also to a grant from the Royal Society which is gratefully acknowledged.

In the Report of the Council adopted at the last Annual Meeting attention was called to the Centenary Meeting which the Society celebrates in 1939. The cost of the Journal in that year will be heavy. This will, it is hoped, be met out of income. But with regard to the expenses of the meeting, which on that occasion will inevitably exceed our normal expenditure, the sum of £100 has been reserved in the accounts. This amount, however, it should be noted, will not be adequate to meet the Society's liabilities incidental to such a meeting. I propose therefore shortly to issue an appeal to Fellows, feeling assured that the opportunity will be welcomed to contribute to a Centenary Fund in order that the occasion shall be worthy of our Society, which, from its inception, has played the leading part and accomplished so much in the development of the microscope as a scientific instrument and its universal applications in science and in industry, both in this country and throughout the world.

Dr.

INCOME AND EXPENDITURE ACCOUNT FOR

1936. £ s. d.	EXPENDITURE.	£ s. d.	£ s. d.
83 11 7	To Balance, being Excess of Expenditure over		
(Credit balance)	Income at 31st December, 1936		123 3 11
166 17 2	„ Rent, Lighting, Heating, Telephone and		
	Insurance		165 18 8
353 10 0	„ Salaries, Reporting, etc.		354 0 0
	„ Sundry Expenses—		
	Library Books and Binding	14 13 10	
	Stationery, Printing, Postages and Sundry		
	Expenses	52 13 8	
	Repairs and Renewals to Furniture, etc.	3 18 1	
	Refreshments at Meetings	9 9 7	
105 5 5			80 15 2
	„ Journal—		
	Expenditure—		
	Printing	416 4 7	
	Editing and Abstracting	216 3 4	
	Illustrating	32 6 7	
	Postages and Addressing	32 7 9	
		697 2 3	
	Less Receipts—	£ s. d.	
	Royal Society Grant	75 0 0	
	Sales	459 14 1	
	Advertisements	74 3 0	
		608 17 1	
454 2 3			88 5 2
22 9 3	„ Depreciation on Furniture		20 4 5
	„ Reserve for Expenses in connection with the		
	Centenary Meeting		100 0 0
	„ Superannuation Reserve—		
	Annual Instalment	100 0 0	
	Interest	7 2 6	
103 10 0			107 2 6
<u>£1122 2 6</u>			<u>£1039 9 10</u>

THE YEAR ENDED 31st DECEMBER, 1937.

Cr.

1936.			INCOME.					
£	s.	d.				£	s.	d.
			By Subscriptions	.	.	754	18	8
			„ Subscriptions for 1937 unpaid	.	.	44	16	0
839	3	0						
44	4	6	„ Donations and Sundry Receipts	.	.			
			„ Interest on Investments and Deposit Account	.	.			
			—Gross	.	.	140	5	9
			Less: Income Tax deducted	.	.	18	3	10
115	11	1						
123	3	11	„ Balance, being Excess of Expenditure over					
			Income at 31st December, 1937	.	.			

£1122 2 6

£1039 9 10

AT 31st DECEMBER, 1937.

ASSETS.		£	s.	d.	£	s.	d.
I. <i>Furniture and Equipment</i> —							
As at 31st December, 1936	.	202	4	0			
Less : Depreciation at 10%	.	20	4	5			
					181	19	7
II. <i>Investments at Cost</i> , less amounts written off					2699	4	2
£400 London & North Eastern Railway Co. 3% Debenture Stock.							
£500 Nottingham Corporation 3% Irredeemable Debenture Stock.							
£915 11s. 4d. India 3% Stock, 1948.							
£150 Metropolitan Water Board "B" Stock.							
£612 London Midland & Scottish Railway Co. 4% Preference Stock.							
£200 New South Wales 5½% Loan, 1947-57.							
£200 5% Conversion Loan, 1944-64.							
£100 3% Conversion Loan, 1948-53.							
£421 1s. 0d. 3½% War Stock (Registered).							
£400 3½% War Loan (Bearer).							
Note.—The Market Value of the above investments at 31st December, 1937, was approximately £3490.							
III. <i>Sundry Debtors</i> —							
Subscriptions unpaid and amounts due in respect of Journal Sales, Advertisements, etc.					153	4	0
IV. <i>Cash at Bank and in Hand</i> —							
At Bank on Deposit Account	.	400	0	0			
At Bank on Current Account	.	232	16	2			
In Hand	.	13	6		633	9	8
V. <i>Income and Expenditure Account</i> —							
Balance, being Excess of Expenditure over Income, as per Account attached					96	7	3
					£3764	4	8

a true and correct view of the state of the Society's affairs, subject to it being noted that no account has been taken of the value of the Society's Library, Stock of Journals and Collection of Instruments (valued for insurance, together with the Furniture and Equipment at £7000).

(Signed) THOMSON McLINTOCK & CO.,
Chartered Accountants, Hon. Auditors.

1, Oxford Court, London, E.C.4.

STATEMENT OF MEMBERSHIP AT 31st DECEMBER, 1937

Number of Fellows on Roll at 31st December, 1936 . . .	474	
Less : Honorary Fellow died in 1936 but included in error	1	
	<hr/>	473
Add : Fellows elected during year	32	
Fellow re-instated during year	1	33
	<hr/>	<hr/>
		506
Deduct : Fellows resigned during year	12	
Fellows removed during year	11	
Fellows deceased during year	9	32
	<hr/>	<hr/>
Number of Fellows on Roll at 31st December, 1937 . . .	474	

This total is made up as follows :—

(a) Ordinary Members :

Current year's subscription paid	401
One year in arrear	27
Two years in arrear	12
Subscriptions remitted	2
	<hr/>
	442

Less : Subscriptions paid prior to member's death or resignation	10
	<hr/>
	432

(b) Compounded Members 27

(c) Honorary Members 15 474

On the motion of Mr. C. S. Todd, seconded by Mr. A. S. Edwards, the Report and Accounts were received and adopted.

Mr. F. C. Grigg moved, seconded by Mr. J. T. Jackson, the following resolution, which was carried with acclamation :—

“That the best thanks of the Society be conveyed to Messrs. Thomson McLintock & Co. for their valued services as Honorary Auditors during the past year, which the Fellows gratefully acknowledge.”

Donations were reported from :—

Messrs. Longmans, Green & Co.—

“Transactions of the Bose Research Institute.” Vol. XI. By Sir J. C. Bose.

Mr. G. T. Gurr—

“Biological Staining Methods.” By G. T. Gurr, F.R.M.S.

Mr. C. T. Owen, F.R.M.S.—

“The Micrologist.” Vols. I–III. 1910–16.
105 Miscellaneous micro-slides.

Votes of thanks were accorded to the donors.

Papers.—The following communications were read and discussed :—

Dr. A. F. W. Hughes—

“The Time-Lapse Camera in Embryological Research.”

Dr. E. E. Jelley, F.I.C., F.R.M.S.—

“A New Universal Polarising Microscope and its Use in Crystal Optics.”

Votes of thanks were accorded to the authors of the foregoing communications.

The following **Papers** were read in title :—

W. L. Yakimoff, M.D., D.V.M.—

“A Coccidium from a Middle-Asiatic Monitor.”

Miss K. M. R. Browne—

“The Golgi Apparatus and other Cytoplasmic Bodies in *Spirostomum ambiguum*.”

N. Ingram Hendey, F.L.S., F.R.M.S.—

“*Pseudoamphiprora Fugei* spec. nov. A New Diatom from Canned Fish.”

P. N. Bhaduri—

“Root-Tip Smear Technique and the Differential Staining of the Nucleolus.”

Announcements.—The Secretary made the following announcements :—

The next Ordinary Meeting of the Society will be held on Wednesday, October 19th, 1938.

The next Meeting of the Biological Section will be held on Wednesday, November 2nd, 1938.

SUMMER VACATION.—The Rooms of the Society will be closed for the Summer Vacation from August 15th to September 10th, 1938.

The Proceedings then terminated.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

SEPTEMBER, 1938.

TRANSACTIONS OF THE SOCIETY.

VIII.—TUMOUR STRUCTURE AND TUMOUR PROBLEMS.

By W. J. PURDY, M.B., F.R.M.S.

(National Institute for Medical Research)

(Read March 16th, 1938.)

THREE PLATES.

THE extent to which the microscope has been used and, indeed, still is used in cancer work is not generally appreciated. Probably one can say with perfect truth that the microscope has been more extensively and more intensively used in the study of cancer than in the study of any other disease. Present dependence on the microscope is revealed in the fact that the whole of our basic classification of tumours depends on histological information obtainable only by means of the microscope. Microscopical examination of tumour tissues is a daily routine in the pathological departments of our hospitals at the present time, for the surgeon must know as exactly as possible what kind of tumour he is dealing with so that from past experience of the behaviour of similar tumours in similar situations he may form a more accurate opinion as to the condition and prospects of his patient. Cancer, then, is a subject of especial interest to microscopists in general, and a simple account of some aspects of cancer knowledge and problems may not be out of place at a meeting of this Society.

What is cancer? Why can't you find a cure? What is the cause of cancer? Why all the difficulty? Is cancer so very different from other diseases? These are questions often heard, and, though I can give no completely satisfactory answers, I would talk awhile this evening about things

of which those who ask such questions are seeking information. To any who desire a more profound and more closely reasoned discussion I would commend the published summary of a lecture recently given before a gathering of Fellows of the Royal College of Surgeons. The lecturer was Dr. W. E. Gye, Director of the Laboratories of the Imperial Cancer Research Fund, and the summary will be found in the current number of the *British Medical Journal* (Gye, 1938).

One often hears cancers spoken of as "growths." The term is an exceedingly good one, for growth is the outstanding and perhaps only known characteristic common to all cancers. A lump appears in some part of the body and grows and grows till at last the patient is overcome. That is characteristic of cancer. Not all tumours have this power of growth in equal degree. Some are so indolent they are of little account and hardly worth calling cancers, whilst at the other end of the scale are cancers which are indeed to be feared. What is it that grows? Of what does a cancer consist? Let us see what information the microscope can give.

It will be noticed that the terms "growths," "new growths," "cancers," and "tumours" are being used this evening as entirely synonymous. Indeed, they are synonymous in ordinary language and for our present purpose there is no reason to use them in any more specialized way. The things themselves, the tumours, cancers, or growths—whichever term you prefer—are of many varieties, as will be gathered from the typical histological preparations to be referred to presently (figs. 1–16). Indeed, at first sight the differences between our several representative tumours may appear so great as to make it difficult to believe that all are simply different manifestations of one disease. Careful study has not always changed first impressions, and some workers, after most thorough consideration, have still preferred to regard tumours as a collection of diseases rather than just varieties of one disease. Which view is the more useful can be finally established only when more is known of the inner secrets of the causation and progress of these conditions. Sufficient for the time being is the conviction that in some sense all typical tumours have something in common so strikingly characteristic that they clearly and naturally separate themselves off from other diseases. Throughout the group there is a similarity of behaviour within the body—a similarity in the peculiar quality and nature of the growth process. The similarity cannot well be absent, I know, for behaviour within the body is the final test which must be passed by all conditions which are to be admitted to the class; but nevertheless the class does seem to be a perfectly natural one. The illustrative microscopical sections to be referred to this evening are of tumours which occurred in several different species of animal. The choice is deliberate and is intended to emphasize this fact that within the body of the host the behaviour of a tumour is similar whatever the species in which it occurs—fowls included. The inclusion of fowls is stressed in view of recent controversies. It is generally conceded to-day that, within the body of the host, tumours of fowls behave in just the same way as tumours of mammals.

As a basis for the description of cancer characteristics we may take the tumour known as Mill Hill No. 2 (fig. 1). It is a fowl tumour. Its name is easily explained. The tumour came second in a series of fowl tumours discovered by Dr. Begg (1927) now of Dunedin University, New Zealand, but at that time working at the Mill Hill Laboratories of the Imperial Cancer Research Fund. The tumour was later studied with great care in collaboration with Dr. J. A. Murray of this Society, who at that time was director of the Laboratories (Murray and Begg, 1930). You will see that the tumour consists of a mass of cells—mostly healthy—and that multiplication of these cells *in situ* is a prominent feature: mitotic figures are to be seen dotted here and there throughout the section. In inflammations, for example, one commonly sees destruction of tissue as a prominent feature and commonly, too, the cells which contribute to increase in bulk of the part have been produced outside the affected area: local multiplication of cells is not there a prominent feature. In the tumour under discussion, as in highly active tumours generally, the arrangement of the cancer cells does not suggest organization for any recognized functional activity useful to the host. Indeed, the more clearly the cellular arrangement suggests functional usefulness the less intense are the cancerous properties likely to be and the less the tumour is to be feared.

The accepted view of the origin and development of each and every individual tumour—and the view is supported by all that is known—is this: In the very beginning one or two or more cells—always a few, but we know not how many—become possessed of an urge to multiplication beyond anything that can be controlled by the growth-regulating forces of the body. These cells are the first tumour cells. They begin to multiply. After a time—we know not how soon, but certainly quite early—no more normal cells become cancerous, the whole of the cancerous elements of the growing tumour being thenceforward formed solely of cells which are direct lineal descendants of cells which became cancerous at the beginning. As multiplication continues and the cell-mass increases in size the surrounding normal tissues supply blood vessels by which the tumour cells may receive nourishment, and a framework or stroma by which the tumour cells may be supported and held together. The cells of stroma and of blood vessels are not themselves cancerous: they are just normal cells serving the needs of the cancer cells. This conception of tumour development explains how it is that in any given tumour the cancer cells are all of the same cell-type. The cells are all of one family: they are the direct descendants of the original cells to become cancerous. Thus we find that all the cancer cells will be epithelial cells in one tumour, muscle cells in another, connective tissue cells in another, and so on, the cell type depending on the type of cells which became cancerous right at the beginning. Why only one type of cell becomes cancerous at one time is still something of a mystery.

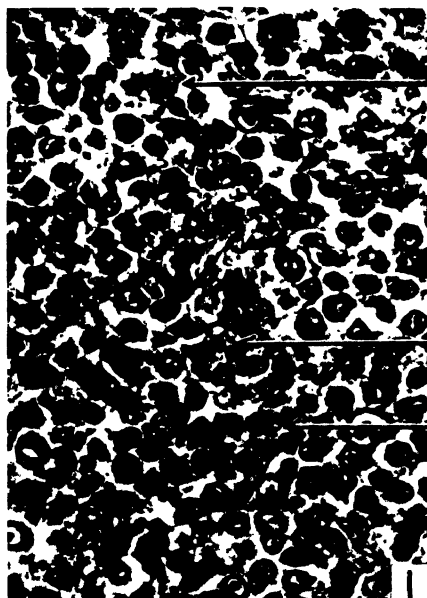
Thus differences in type of cancer cell combined with differences in the amount of stroma account for the widely different histological appearances to

be found amongst tumours. The tumour we are taking as our particular example of the cancer class, the Mill Hill Tumour No. 2, arose from the endothelium of blood vessels. In it the stroma cells are difficult to recognize. They form a scattered and relatively small part of the tumour mass and are very similar in appearance to the cancerous endothelial cells which, as we saw, are the essential cells of this particular tumour. In some varieties of tumour, cancer cells and stroma cells are more easily distinguishable.

Now let us consider more closely the mode of growth of a tumour. In the particular example we are discussing one can see from the number of mitotic figures to be recognized that cell division is actively going on throughout the mass. This means that the tumour must be expanding like a lump of dough. Where growth is solely of this character the cancer is not greatly to be feared. Left to run its natural course it may exert dangerous or even fatal pressure on neighbouring organs, but as a rule there is possibility of cure by complete excision. But another and more dangerous type of growth is often seen in addition to the expansive one just described. At the edges of the tumour the cancer cells begin to invade the surrounding tissues. Later on we shall come across the phenomenon in another fowl tumour (fig. 5), but here also, in Mill Hill No. 2, it is a very prominent characteristic. If we move our section till we come to the edge of the tumour, we find the cancer cells streaming off between the adjacent muscle bundles. They are just like an invading horde which is as healthy and vigorous as can be and is multiplying rapidly as it goes. Presently the expanding mass of these invaders will push the muscle bundles further and further apart; finally the muscle bundles will disappear; and then the invading tumour cells will have completely replaced the muscle tissue. It will be appreciated that the complete excision of such a tumour is vastly more difficult than the complete excision of a tumour which shows purely expansive growth; difficulties in locating the furthestmost limits of the invasion are enormous, and the amount of normal tissue to be taken away if all the contained tumour cells are to be removed may well be incompatible with life.

Tumours which infiltrate surrounding tissues are apt to spread to distant parts of the body. This is what happens: In the course of the infiltrative process a lymphatic vessel or a blood vessel may be penetrated. Then the cancer cells, which always tend to follow the path of least resistance, may grow along the lumen of the vessel. Presently tiny masses of tumour cells break loose and are swept along in blood or lymph stream, as the case may be. When one of these tiny masses happens to come to rest where conditions are favourable for the growth and multiplication of its constituent cells, the tiny tumour mass begins to enlarge, neighbouring tissues supply blood vessels and stroma, and soon the little colony of tumour cells has itself become large enough to endanger the life of the host. Lymph glands, lungs, liver, and even bones are common sites of such colonial growths, the favourite site of colonization varying from one kind of tumour to another.

Now let us examine in detail others of our histological sections of repre-



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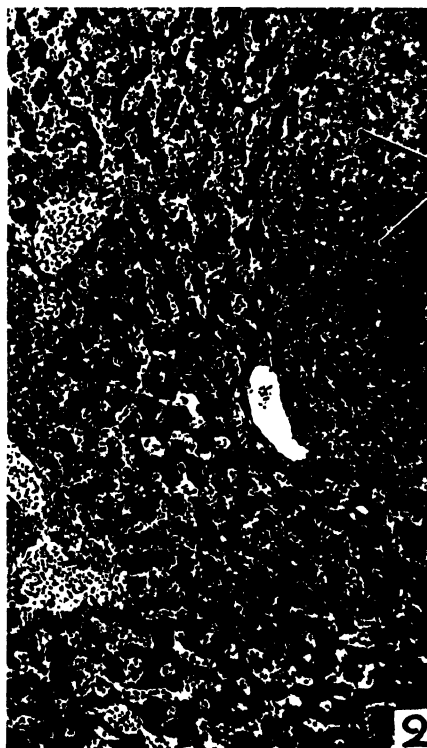
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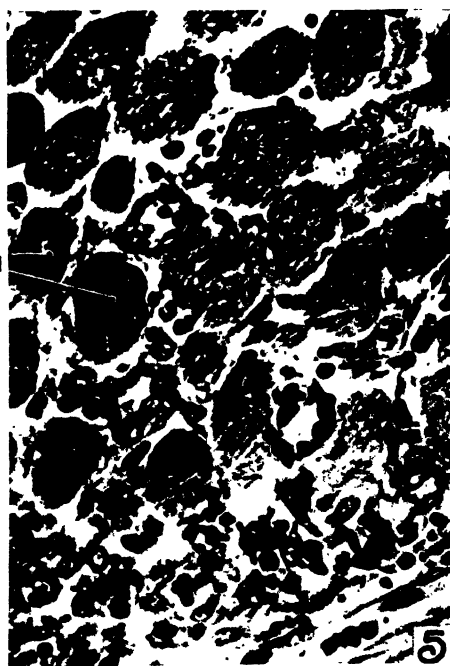
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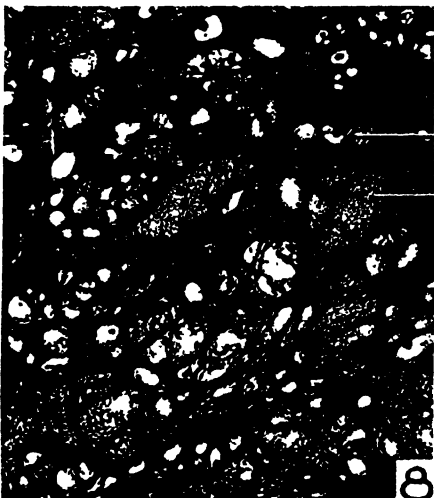
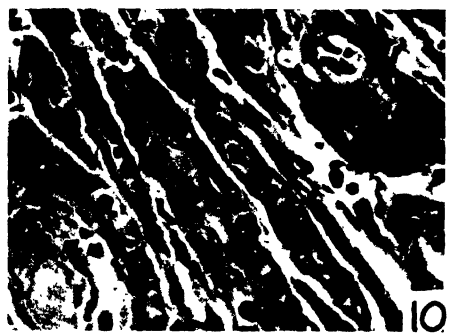
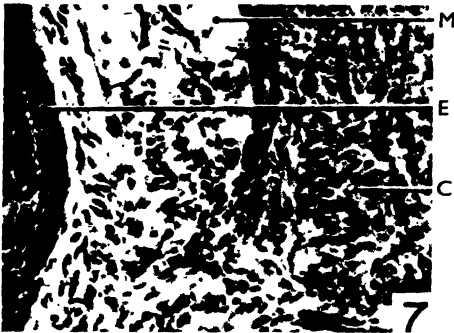
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sentative tumours, looking the while for evidence of the tumour characters so far discussed and noting wherein statements already made may need qualification or amplification.

First comes a section of fowl liver (fig. 2) in which are several small masses of tumour cells. These are colonies or metastases from a Mill Hill Tumour No. 2 situated in the breast muscles of the bird. The section is shown in order to illustrate the expansive type of growth found in tumours. Around the larger nodule the ordinary regular pattern of the normal liver is distributed. There is now a suggestion of stratification or lamination. Clearly here, at the margin of the tumour nodule, the liver tissue is being compressed and stretched by expansion of the tiny colony.

Next (figs. 3, 4, and 5) we have a connective-tissue tumour in the breast of a fowl. In this instance the tumour bears the name of Fujinami, a Japanese pathologist who died a few years ago. The section is shown to illustrate more clearly and exactly what is meant when we say that the cancer cells of a given tumour are all of one cell-type. A certain amount of variation is not excluded. Even highly differentiated and specialized normal cells of the adult body are capable, as you know, of considerable variation in form and function; whilst in the embryo, capacity for variation is greater still. Cancer cells also are capable of variation. It will be seen from the section that the cancer cells in one part of this tumour may differ considerably in form from the cancer cells in another part, though clearly one and all are connective-tissue cells. The cancer cells in some parts of the tumour (fig. 4) are quite plump, take the form of short spindles, and are closely packed together. In other parts (fig. 3) the tumour cells are more loosely arranged: in some parts, indeed, the tumour cells are very slender, are branched and are widely separated from one another by non-staining intra-cellular substance. Yet there are limits to the range of variation and pathologists are convinced that by a close study of the cancer cells and a consideration of the position in which the tumour arose, it should be possible to determine the kind of normal cell which became cancerous in the first place, and hence the correct classification of the tumour.

In this same section of Fujinami tumour which we are at present examining there are some areas (not illustrated) in which most or all of the cells, both cancerous and normal, are dead. Such areas of complete necrosis often occur in cancers, especially in those which are growing very rapidly. But even so the outstanding feature of a tumour is growth: growth which seems to be independent of the needs of the body.

In this same section, too, at the edge of the tumour (fig. 5) the cancer cells are invading adjacent muscle, just as we saw cancer cells invading muscle in our section of Mill Hill No. 2 tumour.

The next section (fig. 7) shows the structure of a connective-tissue tumour which was found growing just beneath the skin in a dog—at least, the tumour is thought to have been derived from connective tissue cells, but the possibility that it actually arose from skin cells cannot be altogether excluded.

The cancer cells are in the shape of short spindles and are here, perhaps indistinguishable from the poorly differentiated cells of tumours which sometimes arise from epithelial cells. The section is shown to illustrate the difficulties which in actual practice are met with in attempts to classify tumours by present methods and criteria. Often, indeed, it is hardly possible to say whether the swelling under examination should be classed as a tumour at all. But typical tumours can be recognized with ease and certainty and these are the ones we are mainly discussing this evening.

In the study of tumours we are continually running up against this puzzling phenomenon of de-differentiation. Cancer cells derived from highly specialized normal cells of adult type usually show a more or less pronounced tendency to resemble their embryonic prototypes. Similar tendency to revert to more primitive type is often seen when normal cells are grown in tissue-culture. In tumours the tendency seems to be linked up in some way with the process of cancerization, for observations show that as a rule the more closely the cancer cells approach embryonic type the more likely is the tumour to grow rapidly, infiltrate, and colonize. The phenomenon is quite unexplained and seems likely to remain unexplained until more is known of the source of the cancerous characteristic, the urge to multiplication. Owing to the process of de-differentiation it happens that cancers derived from highly specialized normal cells may closely resemble cancers derived from less highly specialized cells of the same cell-type. This provides another source of difficulty when attempts are made to determine with extreme exactitude the cell of origin of a given tumour.

The next section (figs. 9 and 10) is of an artificially produced cancer of the skin. The section has been loaned to me by Dr. Argyll Campbell of the National Institute for Medical Research. Dr. Campbell placed a number of mice in a box and then six times a day blew into the box, as a cloud of no great density, dust which had been swept up from the public roads near the Institute. The dust, of course, contained tar and after some six months the mice began to develop tumours of the skin much as mice do when actually painted with tar in the ordinary way. The section which you see, was prepared from the tumour of one of Dr. Campbell's mice. The cancer cells are here of entirely different character from those you have seen so far. They are rounder, larger, and more closely arranged: in fact, they are of epithelial type, not endothelial or connective-tissue, as in the tumours previously mentioned. In parts of this section of skin cancer numerous columns of tumour cells are seen to be invading the deeper tissues. The skin surface is ulcerated. The cancer had formed colonies in a lymph gland, and in the lungs. Evidently the tumour was one of a highly dangerous character. In fact, the mouse actually died of its cancer.

The next section (fig. 8) is from a tumour of cartilage. It occurred in man. The cells show comparatively little disturbance of their power of producing more or less normal cartilaginous ground-substance. Corresponding to this somewhat close approach to the normal is the fact that such tumours are

not, as a rule, possessed of cancerous properties in high degree. These cartilaginous tumours, it may be noted, often arise in multiple foci. A few kinds of tumours do tend to arise more or less simultaneously but independently in several widely separated sites in the one individual, but most kinds of tumours arise from normal cells at one site only.

The next histological section (fig. 6) is one kindly given to me by Sir Patric Laidlaw. It is of a rabbit lung and shows a mass of more or less clearly recognizable plain-muscle cells. The muscle cells are cancerous: the whole is a colony derived from a tumour which arose in the uterus of the animal. There was also a large colony in the spleen. The lung section illustrates the poor adaptation to ordinary functional usefulness so characteristic of new growths. The muscle cells in our section are arranged in a sort of matted mass. What useful purpose could be served by such an arrangement is difficult to imagine. What would happen if the cells were to contract? There is a similar kind of tumour frequently found in the human uterus, but in these there is little tendency to infiltrate and to colonize.

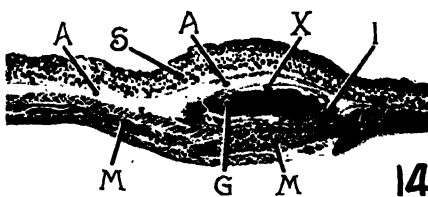
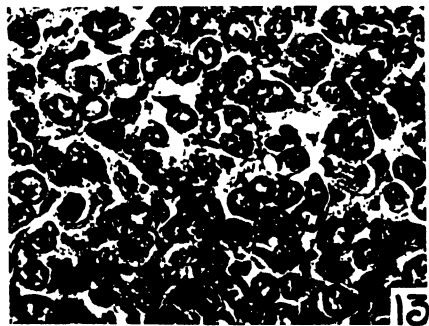
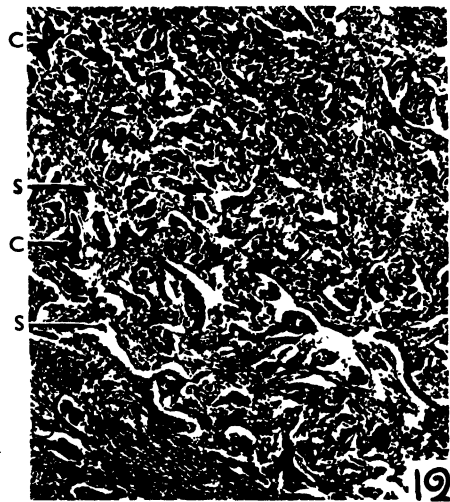
Next, and last of the series, we have sections of two tumours derived from glandular epithelium (figs. 11 and 12). Both occurred in the breasts of women. In both there is a relatively large amount of stroma: indeed, there is usually so much of this kind of tissue present in these tumours that many workers are disposed to regard it as being here a defensive reaction on the part of the body rather than a reaction purely helpful to the cancer cells. The two sections are shown to illustrate the fact that tumours presenting different degrees of cancerous tendency may arise from one and the same type of normal cell, a phenomenon which has been referred to already. In one tumour (fig. 11) the cancer cells are still arranged as a complete unicellular layer lining gland-like spaces. This tumour seems to have grown only in an expansive way. In the second tumour (fig. 12) there is more confusion in the way the cancer cells are arranged, and the cancer cells show a tendency to invade the surrounding tissue. Tumours of this kind are apt to colonize readily. This is by far the more formidable of the two tumours. The growth energy of the cancer cells is apt to vary from one part of a tumour to another, and it seems quite possible that a tumour which in the beginning shows only the expansive type of growth, as in fig. 11, may later begin to infiltrate and to colonize, as in the kind of tumour shown in fig. 12. I wonder why.

So far I have been trying to indicate how it is that in cancer attention has become concentrated on the cells. Now we must ask in what essential respect cancer cells are different from ordinary cells of the body. Whence this inexhaustible, uncontrollable urge to multiplication? That is still the central problem of cancer. Much remains to be discovered in this field of enquiry, but at any rate we do know where to look for the explanation of this puzzling property of cancer cells. Our knowledge is derived from studies of tumour transplantation or grafting. The formation of new tumours by the process we have likened to colonization is not limited to the body of the tumour-bearing host. If a fragment of living tumour tissue be taken from

one individual and placed under the skin of another individual of the same species a new tumour may develop at the site : the original tumour has been transplanted to a new host. Tumours differ widely in the readiness with which they can be transplanted, but to-day, in laboratories in various parts of the world, tumours which have proved transplantable with ease are being maintained in propagation by serial transplantations. Such transplantable tumours—generally tumours of rats and mice—provide a ready source of material suitable for certain kinds of scientific investigation.

This process of transplantation or grafting was studied long ago. Jensen (1903) seems to have been the first, and then came Bashford and Murray (1905). The findings of these early workers have been confirmed and are now generally accepted. Let us take a particular example. Mouse tumour 2146 of a series studied by the staff of the Imperial Cancer Research Fund arose from skin cells as a result of repeated local applications of tar. The structure of the tumour and the character of its essential cells—the cancer cells—may be seen from fig. 13. The actual piece of tumour tissue which provided the microscopical section also provided a bit of tissue, about the size of a pin-head, which was placed under the abdominal skin of a young and perfectly healthy mouse. Three days later the whole area of abdominal wall containing the intact and undisturbed graft was removed and fixed. Sections of this preparation are shown in figs. 14 and 15, and illustrate how a tumour develops from a graft. This is the accepted story : in the centre of the grafted fragment all cells die, presumably for want of nourishment. But in the thin peripheral layer, where conditions are better, cells survive and before long begin to multiply and penetrate the surrounding host tissues. These stages are all to be recognised in the figures, where the fine large healthy cells invading the surrounding loose connective tissue can be recognized as cancer cells. The cancer cells continue to multiply, vessels and stroma are supplied by the new host, and soon a tumour dangerous to that host has come into being. The whole of the cancer cells of the new tumour are direct lineal descendants of implanted cancer cells. All implanted normal cells soon die. In transplanted mouse tumours, as in transplanted mammalian tumours generally, no cells of the new host ever become cancerous. That at least is the general opinion, and where conditions are favourable for accurate observation it is known to be true.

Consideration of these findings leads to important conclusions. As we have seen, the grafted cells multiply readily in perfectly healthy animals. This means that the cancerous condition of these cells is not maintained by any abnormal general bodily condition. No circulating toxin can be responsible ; no lack or excess or perversion of any bodily quality ; no weakness, for example, in that mysterious growth-regulating power which prevents normal cells from multiplying beyond limits useful to the body as a whole. No cells of the new host become cancerous, as we have seen ; and if the inoculum contains no living cancer cells it fails to produce a new tumour. Thus, in these mammalian tumours, each cancer cell must itself be a self-contained



cancer unit, and in or on the cancer cell is where we must look for that which maintains the cancerous condition.

But what of those tumours in which a virus is known to be present? Well, in the only case that can be adequately tested the answer is perfectly clear and is the same as for those tumours—mammalian tumours for example—in which the presence of virus cannot be demonstrated. The known virus tumours have appeared almost solely in the domestic fowl and are transmissible from fowl to fowl by tumour extracts which have been filtered free of all cells. The Mill Hill Tumour No. 2 and the Fujinami tumour have been referred to already. Both belong to this class. But perhaps the most widely known of all the class is the Rous Tumour No. 1 (Rous 1910), and it is this tumour which yields the information we seek. It is a tumour of fowls, just as the others are, but it presents one peculiarity: it will grow in newly-hatched ducklings—and living cells are necessary for the transfer. Tumour tissue taken from a fowl is minced and then about half a cubic centimetre is injected into the leg muscles of a duckling. A new tumour (fig. 16) develops at the site of inoculation, grows rapidly, and may kill the duckling. Minced tissue from this new tumour may be used to produce a tumour in another duckling—and so on from duckling to duckling indefinitely. Careful studies (Purdy, 1932, 1933) of this process of transfer from duckling to duckling show that the tumour cells always remain fowl cells, that no duck cells ever become cancerous, and that the virus obtainable from tumours grown in ducklings has characters one associates with virus derived from fowl tumours rather than from duck tumours. Thus the cancer cells are here simply growing in the ducklings as in a tissue-culture medium, and the whole of the cancer cells are direct lineal descendants of the implanted cells. Here, then, though we are dealing with a tumour known to contain virus, the conditions are just the same as in grafted mammalian tumours. The conclusions too are the same: if we wish to know what maintains the cancerous condition of the tumour cells we must search in or on the cancer cell itself.

To know where to look is valuable: do we know what to look for? Not with like certainty, but we are not without apparently sound indications. During the second decade of the present century, as the result of intensive studies of mammalian tumours, almost universal acceptance was gained for the opinion that cancer cells must differ in some heritable morphological way from normal cells and that to this physical difference must be attributed the observed uncontrollable tendency to multiplication. Microscopists sought diligently for such a difference, but failed to find any morphological detail in which all cancer cells are unlike all normal cells. But the failure only leaves us where we were. The method may be inadequate: the change from normal cell to cancer cell might be, for example, as some have thought, simply a change in genetic constitution.

But suppose the change is of an entirely different kind, as personally I believe it is, then the chances of a successful outcome of microscopical research

in this field may well justify renewed efforts. The opinion is gaining ground to-day that in the cancer cell the maintenance of constant urge to multiplication may be due to the continued presence of an intracellular virus. In some tumours a virus is known to be constantly present: why not in all? The possibility cannot be denied or even ignored, for there are no known facts in conflict with such a suggestion and there are some considerations definitely in its favour. As we have seen, in the tumours in which no virus can be found the behaviour of the cancer cells within the body of the host is exactly like the behaviour of cancer cells of tumours in which a virus is known to be present—the phenomenon of colonization not excepted. Suggestive is the fact that in some cases evidence of a virus has been found in tumours which, examined by all ordinary methods, would still have had to be classed as non-viral. The Rous Fowl Tumour No. 1 sometimes passes into a phase in which virus cannot be detected (Gye and Andrewes, 1926), but virus must still be there, for presently, with continued transplantations, the phase may change again and virus again become readily detectable; and Foulds (1937) has reported an instance where a new technique has revealed evidence of virus in a fowl tumour in which none had been discoverable by other means. This question of whether a virus can be present in all tumours is of the greatest importance at the present time and further discussion of the general position would seem to be warranted this evening.

Up to this point we have discussed only cells which are already cancerous. Now we must ask what causes cells to become cancerous in the first place: in fact, we must ask what causes cancer. Viruses may cause cancer we know. If, for example, we take a saline extract of Rous Fowl Tumour No. 1, filter the extract through a bacteria-proof candle, and then inject the filtered extract into the muscles of a normal fowl a new tumour will develop at the site of inoculation. There is here no question of grafted cells, for no cells whatever are present in such inocula. The extract causes normal cells to become cancerous, and most of those who have worked with this and similar tumours believe the effective agent to be a virus present in the extract. But we know also of a number of non-viral causes of cancer.

Hereditary tendencies to cancer, though by no means a prominent feature in man, can be clearly demonstrated in mice under very special conditions. By intensive selective inbreeding strains of mice have been produced in which some 80 per cent. of all adult females eventually die of cancer of the breast; and by similar means other strains have been produced in which cancer of the breast appears in only some 1 or 2 per cent. of all adult females or even never appears at all. Clearly heredity is here of overwhelming importance. What change is inherited is not known. That the inherited tendency is not independent of environmental factors is shown by the recent observation (Bittner and Little 1937, Bittner 1937) that if new-born mice of a cancer-susceptible strain be fostered on to a mother of a cancer-resistant strain, then the chances that these young mice will suffer from cancer of the breast in later life are very greatly reduced; conversely, if young of a cancer-

resistant strain be suckled on to mothers belonging to a cancer-prone strain, then their liability to cancer of the breast later on is enormously increased.

Various chemical and physical agents can determine the appearance of cancer. Tar and certain mineral oils cause cancer under industrial conditions as well as in experimental animals. The same is true of X-rays and of radio-active substances ; and a large number of cancer-producing chemicals have been discovered during the past few years by workers at the Cancer Hospital.

Oestrin is a very important cancer-producing agent (Lacassagne 1932). The substance occurs normally in the circulating fluids of the body, particularly in women, where it is found as an internal secretion of the ovary and placenta. Repeated applications of oestrin to the skin of mice will cause cancer of the breast. In women too the same influence has been detected recently (Herrell 1937) : it has been found that women in whom the ovaries have been removed for quite other reasons are distinctly less liable to suffer from cancer of the breast than are normal women of similar age. These observations are suggestive. A substance normally found in the body is shown to be capable of influencing the occurrence of cancer. How many other such circulating bodily products are there which in excess or deficiency or in perverted quality may produce cancer ? Time will tell.

Cancer is not contagious. But this observation does not help us much in our enquiry as to the possibility of virus being present as a causative agent in cancers. Virus tumours themselves are not contagious. Normal fowls allowed to run freely with fowls which have been inoculated with virus tumours never contract the disease as a result. Is the demonstration of non-viral causes similarly inconclusive ? Are all the known causes of cancer really as independent as they seem at first sight ? There is now definite evidence that there can be co-operation between a viral and a non-viral cause. Rous—the American worker who discovered the fowl tumour which bears his name—and his co-workers (Rous and Kidd, 1936) have recently reported the following experiment : at intervals one ear of a rabbit was painted with tar until small warts began to appear in the tarred area. Then virus from a Shope rabbit-papilloma, a wart-like condition which if given time will often become frankly cancerous, was injected into the normal ear of the tarred rabbit. A rapidly growing, infiltrating tumour promptly appeared in the tarred area. The tumour appeared much earlier and was more active than tumours which are produced either by tar or by virus when acting alone. The virus had become localized in cells which in some sense had been sensitized by the tar. It may be mentioned in this connection too that the apparently non-viral tumour in which Foulds (1937) did at last succeed in finding evidence of virus was a transplantable tumour of fowls, and had been produced originally by dibenzanthracene, a chemical substance of known constitution. In view of these experimental findings and in the absence of any conclusive evidence to the contrary, it seems to me, as it

has seemed to others, that one must at least admit the possibility that some or all of the other non-viral causes of cancer may really act, as tar must do, by facilitating virus infection of the cell.

Now what can the microscope do to help? You will have realised how urgently we need to know with absolute certainty whether or not all tumours are virus tumours. The solution of this question seems not to be far beyond the powers of the present-day microscope. There is much good evidence that even the smallest of the known viruses are not much smaller than objects which can now be resolved. As a result of centrifugation and of filtration experiments (Elford and Andrewes, 1935, 1936) it is known, for example, that the infective agent of the Rous Fowl Tumour No. 1 is particulate, and that it is probably about 75 millimicrons in diameter. We know, too, precisely where to look for the virus, for since the cancer cell is a complete and self-contained cancer unit it is in—or, less probably, on—the cancer cell that we must look. Because the cancer cell is the cancer unit it follows too that the causal virus which we seek must be present in each and every cancer cell: and a helpful corollary to this is that no object which is not present in each and every cancer cell of a given tumour can be the causal virus of that tumour.

With the questions of what cancer virus or viruses may be expected to look like and how they may be identified we run right into the far larger problem of the nature of viruses in general. Mr. Barnard, our President, by highly developed methods of ultra-violet micrography has been able to find and identify a number of the larger pathological viruses. They have been found and identified largely because they closely resemble ordinary micro-organisms in appearance and in the way they group themselves in the diseased tissues. Mr. Barnard, as many of you will remember, has shown before this Society very convincing photographs of the viruses of, for instance, infectious ectromelia and foot-and-mouth disease. But what will still smaller viruses look like? Will they too have a complex and organized structure more or less closely resembling what we are familiar with in ordinary micro-organisms, or will their constitution be of a much simpler order? The question is raised to special prominence at the present moment by the insistence which is being placed upon relationships which the smallest viruses—that of tobacco mosaic, for example—bear to non-living matter. So here in the question of whether there is a causal virus present in all cancers and in the wider question of the morphological characters of the smaller viruses, in general, are problems peculiarly microscopical in nature. Truly these problems are as important, as intriguing, as promising, and as difficult as any which microscopists have been privileged to face.

SUMMARY.

1. Selected correlated items of established cancer-knowledge are described and discussed.

2. It is pointed out that, notwithstanding the discovery of virus-cancers, all the evidence still indicates that the reason for the continued cancerous urge to cell multiplication must be sought in the cancer cell itself.

3. To establish with certainty whether all cancers are really virus-cancers is pointed out as a promising microscopical problem of the highest importance.

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DESCRIPTION OF PLATES.

All the figures are from photo-micrographs kindly made by Mr. F. Welch, F.R.M.S. They are from stained preparations.

PLATE I.

- FIG. 1.—Endothelioma Mill Hill No. 2. $\times 475$. From the breast of a fowl. Practically all the cells are cancer cells. Three dividing cells are indicated (M).
- FIG. 2.—Endothelioma Mill Hill No. 2. $\times 110$. Colony or metastasis (C) in liver of fowl. Primary tumour was in the breast muscles. In the upper part of the area shown the normal liver pattern has become distorted by expansive growth of the tumour colony. The numerous dark bodies to be seen in the liver sinuses are the red corpuscles, which, it will be remembered, are nucleated in birds.

FIGS. 3 and 4.—Fujinami myxosarcoma in breast muscles of a fowl. Both are from the same section and illustrate the kind and range of variation in cell form and arrangement to be found in a single tumour. In both figures practically all the cells are cancer cells. $\times 475$.

FIG. 5.—Fujinami myxosarcoma. $\times 475$. The figure is from the same section as the two preceding ones. It shows the advancing edge of the tumour invading voluntary muscle. Practically all the cells are cancer cells. The main tumour mass is at the bottom of the area shown, and from it columns of cancer cells are seen passing in between the muscle fibres (M).

PLATE II.

FIG. 6.—Leiomyosarcoma of rabbit. $\times 475$. Colony or metastasis in lung. The primary tumour was in the uterus. The large spindle-shaped cells are the cancer cells, which here are but little altered in appearance from the non-striated muscle cells from which they arose.

FIG. 7.—Short-spindle-celled sarcoma of dog. $\times 220$. The cancer cells (C) occupy most of the area shown. The normal epithelial-cell layer of the skin is seen at (E) and at (M) are the remains of the subcutaneous muscle layer which is being invaded and destroyed.

FIG. 8.—Chondroma. $\times 110$. This occurred in man. Here cancer cells (C) have still retained the power of producing more or less normal cartilaginous ground substance (M). No stroma is to be seen in the area shown.

FIG. 9.—Tar-carcinoma of skin of mouse. $\times 110$. The whole of the area shown consists of tumour tissue. The surface, indicated by the arrow, has become ulcerated.

FIG. 10.—Tar-carcinoma of skin of mouse. $\times 475$. Part of the area shown in the preceding figure. Practically all the cells are cancer cells.

FIG. 11.—Simple adenoma of the breast of a woman. $\times 38$. Here the cancer cells, indicated by arrows, are seen arranged as a single layer lining gland-like spaces (L). They appear dark in colour in the figure. The rest of the cells, quite numerous, belong to the stroma.

PLATE III.

FIG. 12.—Scirrhus cancer from breast of woman. $\times 38$. The cancer cells (C) are arranged in irregular clumps and in the figure are dark in colour. The associated clefts or spaces (S) are artefacts. Here again the non-cancerous tissue, the stroma, is as great or even greater in volume than the essentially cancerous.

FIG. 13.—Mouse tar-carcinoma 2146. $\times 475$. Practically all the cells are cancer cells.

FIG. 14.—Graft of tumour 2146 in the abdominal wall of a mouse. $\times 7.5$. The cleft (X) which practically surrounds the implanted tissue (G) is an artefact. At each end of the graft (I) tumour cells are seen invading the loose subcutaneous areolar tissue of the new host. (S) is skin and (M) is muscle.

FIG. 15.—Graft of tumour 2146, in abdominal wall of mouse. $\times 475$. The area shown is the same as that seen at (I) in the preceding figure and extends from the inner parts of the graft to the normal tissue of the host. (N) indicates necrotic graft. Pyknotic and fragmented nuclei are numerous. (P) indicates the peripheral layer of the implanted fragment. Here the cancer cells are still healthy. (I) indicates host areolar tissue which is being invaded by cancer cells. (A) indicates still normal areolar tissue of the host. Practically all the cells are cancer cells: a few spindle-shaped cells of the areolar layer are to be recognized at the bottom of the area shown.

IX.—A COCCIDIUM FROM A MIDDLE-ASIATIC MONITOR.

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(Read May 18th, 1938.)

ONE TEXT-FIGURE.

COCCIDIA have been recorded from lizards since 1898, when Hagenmüller described *Isospora camillerii* from *Gongylus ocellatus*. Four years later Ed. Sargent (1902) found *I. mesnili* in a chameleon (*Chamaeleo vulgaris*). *Eimeria pinto* was recorded from a cayman (*Crocodylus* sp.) by Carini (1931); *E. kermorganti* from *Gavialis gangeticus* by Simond (1901); *E. acanthodactyli* from *Acanthodactylus scutellatus* by Phisalix (1930); *E. agamæ* from *Agama colonorum* by Laveran and Pettit (1910); *E. gekkonis* from *Gecko japonicus* by Tanabe (1928). Carini and Pinto (1926) described two species, *E. boveroi* and *E. rocha-limai*, from *Hemidactylus mabujæ*; Carini (1933) also described *Isospora ameivæ* from *Ameiva ameivæ* and (Carini, 1936) *I. hemidactyli* from *H. mabujæ*; while Yakimoff (1936) described *Eimeria mirabilis* from *Ophisaurus apodus* in U.S.S.R.

As regards monitors, Adler discovered an *Isospora* in *Varanus griseus* from Palestine and brought this finding to the notice of Wenyon (1926), but as far as I am aware this form has not hitherto been described.

The material for the present note was obtained from a monitor of the same species (*V. griseus*) brought by veterinary surgeon P. S. Timofeeff from Andijan (Uzbekistan, Middle Asia). In the fæces of this specimen were found oval structures with a fairly thick wall, measuring $10.8-14.4\mu \times 9.0-10.8\mu$, with a mean of $12.8 \times 9.5\mu$, the largest being $14.4 \times 10.8\mu$, the smallest $10.8 \times 9.0\mu$; the Mode $12.6 \times 9.0\mu$; Form-index $1:0.62-0.85$, average $1:0.75$, Mode $1:0.71$. In 1 p.c. potassium bichromate in each of these structures were produced four other oval elements with granular contents. Though kept in the solution for a long period, these four inner structures showed no signs of further development.

There could be no doubt that the structures observed represented coccidia, but their exact nature was open to question.

In a number of recent observations it has been noted that the fæces of some animals frequently contain only the spores, but not the oocysts of coccidia. Thus Yakimoff and Gousseff (1934) found only the spores of

Isospora felis in dogs, which measured $14.4-19.8\mu \times 7.2-12.6\mu$ (mean $17.33 \times 11.70\mu$; Form-index $1:0.44-0.77$; average $1:0.67$); spores alone were also seen by Yakimoff and Matschoulsky (1935) in the case of *I. rivolta*, from a wolf (size $14.4-18.0 \times 10.8-12.6\mu$; medium $15.5 \times 11.04\mu$; Form-index $1:0.67-0.87$; average $1:0.71$). These authors, in 1936, also saw the spores of the same parasite (measuring $10.53-16.84\mu \times 10.53\mu-12.63\mu$) in the faeces of a dog from Leningrad.

As in the cases just mentioned, I regard the structures described from

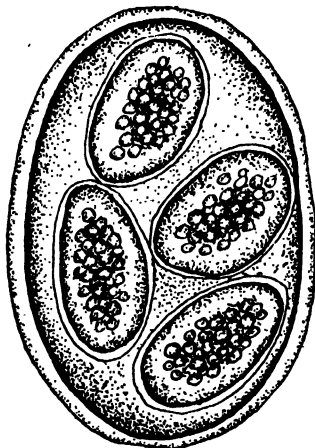


FIG. 1.—Sporocyst of *Isospora varani* n. sp. with four sporozoites.

the monitor as sporocysts, and not oocysts. Apparently the oocysts had broken up in the intestine of the lizard and only the spores were voided with the faeces, each giving rise to four sporozoites when placed in the bichromate solution.

The coccidium of *Varanus griseus*, therefore, represents an *Isospora*, which I propose to name provisionally—in view of the failure to observe the oocysts—*Isospora varani* n.sp.

For reasons explained above it is impossible at present to say whether the form seen by Adler in the same monitor belongs to this species or not.

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X.—THE GOLGI APPARATUS AND OTHER CYTOPLASMIC BODIES IN *SPIROSTOMUM AMBIGUUM*.

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(Communicated by Professor J. Brontë Gatenby. May 18th, 1938.)

THREE PLATES AND TWO TEXT-FIGURES.

INTRODUCTION AND PREVIOUS WORK.

MUCH of the recent work on protozoan cytology has been carried out in this Department, using the osmic and silver techniques which have proved so successful in demonstrating the metazoan Golgi apparatus. In conjunction with these and other more efficient methods, the use of the ultracentrifuge of Beams, Weed, and Pickles (1933) has shed much light not only on the problem of the protozoan homologue of the metazoan Golgi apparatus but also on the decision as to what bodies are pre-existing in the cell and what are artefacts. Further, it is possible by this means to differentiate between the various types of inclusions in the cell on account of variations in their relative specific gravities.

A Golgi apparatus has long been known in one sub-phylum of the Protozoa, namely the Sporozoa. In 1914 Hirschler, in *Monocystis ascidiae*, demonstrated Golgi bodies having chromophile and chromophobe parts typical of metazoan Golgi bodies. Since that time Golgi bodies have been described in other sporozoans by various workers (Joyet-Lavergne, 1923–26 ; King and Gatenby, 1923 ; Tuzet, 1931 ; Daniels, 1938, etc.). There is by no means such complete agreement on the presence of a Golgi apparatus in the other sub-phyla of the Protozoa. A more widespread use of the ultracentrifuge in the future might give important results in this branch of cytology.

As yet there has been no convincing evidence of a Golgi apparatus in the Sarcodina, though various workers have claimed to have shown such structures (Causey, 1925 ; Hirschler, 1927 ; Hall, 1930 ; Hall and Loefer, 1930 ; Nigrelli and Hall, 1930 ; V. E. Brown, 1930). In two members of the Sarcodina recently investigated in this Department no Golgi apparatus has been revealed [*Amœba proteus* (B. N. Singh, 1938, in press) ; and *Nebela collaris* (Mrs. Lamont, 1937, unpublished)]. Much attention has been paid to the Flagellata with a view to solving this homology. Duboscq and Grassé (1925 on) believe that the parabasal, lying at the base of the flagellum, is the homologue of the Golgi apparatus. Sigot (1931), and Patten and Beams

(1936) have described osmiophile bodies round the reservoir of *Euglena*. They say, "The bodies which surround or form the reservoir . . . resemble Golgi material in one way, in that they resist bleaching very effectively. It is, however, well known that osmic acid is readily reduced in the walls of most vacuoles within cells, and that this blackening is often resistant to bleaching. . . . In our opinion the identity of the Golgi material of Euglenoid flagellates is still uncertain." The preparations of Patten and Beams have recently been gone over by Gatenby and B. N. Singh (1938) in this Department. They say, "We believe the osmiophile substance represents the Golgi material of higher forms and with the contractile vacuole constitutes a compound structure." In an allied genus, *Copromonas*, Gatenby and Singh (1938, in press) have described an osmiophile substance in connection with the reservoir and contractile vacuoles, which they homologize with the Golgi apparatus of higher forms. This view is supported by the fact that the impregnated material breaks into two during division of the animal.

On turning to the sub-phyllum Infusoria, to which the genus *Spirostomum* belongs, one finds still further confusion. Nassonow (1924), from investigations carried out on various ciliates (*Nassula*, *Dogielella*, etc.), concluded that the contractile vacuole was homologous with the metazoan Golgi apparatus, since both were lipoidal and both reduced osmic acid. This hypothesis resulted in later workers describing genera which had no osmiophile material in connection with the contractile vacuole. At present Nassonow's theory is not accepted in the form put forward by him.

Richardson and Horning (1931) describe three types of inclusions in *Opalina*—vegetative granules, mitochondria, and Golgi bodies. The latter were seen after Da Fano and Cajal, but it is not stated if they were observed after the Kolatchew method, which is the most reliable method for demonstrating the Golgi apparatus, especially of Protozoa. The bodies varied from irregular granules to twisted, snake-like elements. Miss Patten (1932), using the same method on *Opalina*, described such bodies as figured by Richardson and Horning, but these did not show up after the Nassonow, Kolatchew, or Weigl techniques; hence she concludes that they are artefacts and says there is no Golgi apparatus present in this genus. The same author could reveal no Golgi apparatus in *Nyctotherus* either. One of the greatest stumbling-blocks in protozoan cytology is the failure of the silver methods to demonstrate the Golgi apparatus, and hence much value cannot be attached to Richardson's and Horning's conclusions.

R. Brown (1936, paper unpublished), as a result of ultracentrifuging *Paramecium*, broke the osmiophile canals of the contractile vacuole. These are of a lipoidal nature, since they impregnated with osmic acid, and tend to move to the centripetal pole after centrifuging. Further, using the Aoyama method, he describes crescentic and ring-shaped bodies which after centrifuging move to the centripetal end of the cell. He believes that these bodies are also shown after the osmic methods. Is it justifiable to call these structures Golgi bodies? Brown considers that the evidence in favour of such a

view is inconclusive; probably these are no more than fatty granules. It appears, therefore, that the homologue of the Golgi apparatus in *Paramecium* is furnished by the osmiophile walls of the canals of the contractile vacuole.

In *Blepharisma*, a ciliate belonging, according to Calkins, to the same family as *Spirostomum*, Miss I. Moore (1934) was unable to impregnate the wall of the contractile vacuole with osmic acid. But, using the same technique, small globular bodies in the endoplasm were impregnated, and these she describes as Golgi bodies. It is surprising that such a large protozoan as *Spirostomum*, being as it is 4–5 mm. in length, should have been so little used for cytological investigation. Hirschler (1924) said that in *Spirostomum* and *Opalina* only one type of lipid inclusion is present, and this he says represents both mitochondria and Golgi bodies. He says this is the primitive condition, the differentiation to mitochondria and Golgi bodies only occurring in the more highly organized forms. This statement is obviously incorrect. With the exception of his work there appears to be no other cytological observation made on this ciliate.

It is generally recognized that mitochondria are present in the protozoan body, although there is not universal agreement as to their form. For instance, Richardson and Horning (1931) in *Opalina* describe them as "short, deeply staining rods." Miss Patten (1932) says that Richardson's and Horning's mitochondria and their vegetative granules are two aspects of the same body, and are shown up by methods which normally dissolve mitochondria. By staining *intra vitam* in Janus green, Miss Patten demonstrated very fine granules which she called the mitochondria. These were also shown in Flemming-without-acetic and Altmann preparations, but were never seen in corrosive acetic, Bouin, or alcoholic-fixed preparations. R. Brown (1936) described the mitochondria in *Paramecium* as rods and granules.

In conclusion, I wish to thank Professor J. Brontë Gatenby for suggesting this problem as the subject of my research, and for his advice and criticism.

MORPHOLOGICAL NOTE ON SPIROSTOMUM AND METHOD OF CULTIVATION.

According to Calkins' classification (1933), *Spirostomum* is a heterotrichous ciliate belonging to the sub-class Spirotricha of the Ciliata. The body is uniformly ciliated and bears a lateral peristomial groove which terminates in the mouth. The macronucleus is long and moniliform, extending nearly the whole length of the animal and lying in the extremely vacuolated endoplasm. Micronuclei have also been described (Maupas, 1879; Miss Bishop, 1923). The contractile vacuole is large and situated in the posterior end of the animal. Into it opens a feeding canal which stretches from the anterior end.

The method of cultivation employed was the wheat seed medium recommended by Sister Monica Taylor (1920) for *Amœba proteus* and tried with

success by Miss Ann Bishop (1928) for *Spirostomum*. Long narrow tubes are essential for successful cultures, as also is warmth if the cultivation is being carried out during the winter.

MATERIAL AND METHODS.

The species employed was obtained during autumn in a rather deep pond, having a muddy bottom and abundance of decaying vegetable matter. The number of animals falls off rapidly during winter, and hence the necessity for good cultures.

Spirostomum possesses high powers of contraction; nevertheless, in none of the fixation methods employed were anæsthetizing agents used, for in that case complete reliance could not have been placed on subsequent observations. Sections in every case were cut at 2.5μ . It was found impossible to ultracentrifuge the animals, which burst at all pressures attempted. This is due to the extremely vacuolated nature of the endoplasm. It was found necessary to employ the electrical centrifuge. This was run at top speed (4,000 revolutions per minute) for times varying from 30 to 45 minutes.

The following fixation methods, all described in "The Microtomist's Vade-Mecum" (1937) and in "Biological Laboratory Technique" (1937) were tried:

- (a) Kolatchew method: fixation in Champy's fluid overnight and 7 days' post-osmication in 2 p.c. osmic acid.
- (b) Fixed in Champy's fluid overnight.
- (c) Fixed in Regaud for 2 days and treated with 3 p.c. potassium bichromate for 4 days.
- (d) Weigl method: fixation in Mann's fluid for 1 hour and 4 days' post-osmication in 2 p.c. osmic acid.
- (e) Fixation by Aoyama's cadmium chloride, silver nitrate technique.
- (f) Fixation by Da Fano's cobalt nitrate, silver nitrate technique.
- (g) Fixed in Bouin's fluid for 1 hour and also overnight. Vital staining, in very dilute solutions of neutral red and Janus green, was tried.

Several microchemical tests were employed:

- (a) Sudan IV and Nile blue sulphate for fat.
- (b) Best's carmine and iodine gum tests for glycogen.
- (c) Fixed in Schaudinn's fluid, then treated with 10 p.c. methylene blue and 1 p.c. H_2SO_4 to show volutin.
- (d) Schultz cholesterol test.
- (e) Vitamin C test.

OBSERVATIONS.

I. *The Living Animal*.—The peristome, macronucleus, contractile vacuole with its food canal, the food vacuoles and the vacuolated nature of the endoplasm are all clearly seen in the living unstained state.

Animals were stained in very dilute solutions of neutral red (1/1,000,000 approx.) overnight. This stained up many small granules scattered evenly over the surface of the animal. These were considered to be the basal granules of the cilia. This view is upheld by observations made after centrifuging. Animals were stained, then centrifuged, and it was found that the red granules were not displaced. If the animals were centrifuged and then stained, a similar result was obtained. It is often possible, by careful adjustment of the light, to see the cilia emerging from the granules. Besides these bodies and the large food vacuoles, no other structure took up the stain, even after prolonged immersion in the solution.

It was found impossible to demonstrate the mitochondria with Janus green, even after a long period in very dilute solutions. No structure was stained by this method.

II. *Fixed Material.* (a) *Golgi Bodies.*—These were demonstrated after the following fixation methods: Kolatchew, Champy, and Weigl osmic techniques. They have the form of round granules scattered throughout the cytoplasm, lying on the endoplasmic meshes of protoplasm and in the ectoplasm (Plate I, fig. 1). They are not platelets since the spherical form is the only type seen. These are the only bodies to be impregnated with osmium tetroxide by these methods. After fixation in Champy's fluid, without subsequent post-osmication, the bodies take a brown-black colour. If such a slide be stained in Altmann's acid fuchsin, the brownish Golgi bodies form a sharp contrast with the mitochondria (see later), which take up the fuchsin. In Kolatchew preparations the Golgi bodies are the only structures revealed and here they are black (Plate I, fig. 1). They resist bleaching by 0.5 p.c. potassium permanganate followed by 4 p.c. oxalic acid, and hence they can be demonstrated along with the mitochondria if the slide is treated with acid fuchsin, which stains the latter and does not affect the former (Plate I, fig. 2). Similar bodies are revealed after Weigl fixation, but here there are also many small black granules which stain red after acid fuchsin. These are corrosive-osmium artefacts since, if the sections are brought to water, put into Lugol solution for 5 minutes, treated in 5 p.c. hypo, and then stained in acid fuchsin, the bodies do not take the stain. In a few Aoyama preparations granules, similar to those seen in osmic material, were impregnated. Since these did not appear in all the slides, much reliance cannot be placed on the method.

In preparations demonstrating the Golgi bodies, some of the latter were seen to have a heavily impregnated rim and a lighter centre (Plate I, fig. 1). It is the writer's opinion that these granules are bounded by a lipoidal membrane which first become slightly impregnated with osmic acid, so giving the appearance of a structure having a light centre and dark rim. On further post-osmication the impregnation may become much heavier on the surface of the granule, so giving a uniformly black appearance, or else the substance of the granule may become impregnated, thus giving the same result. The latter view would suggest that the Golgi bodies are solid osmiophile granules

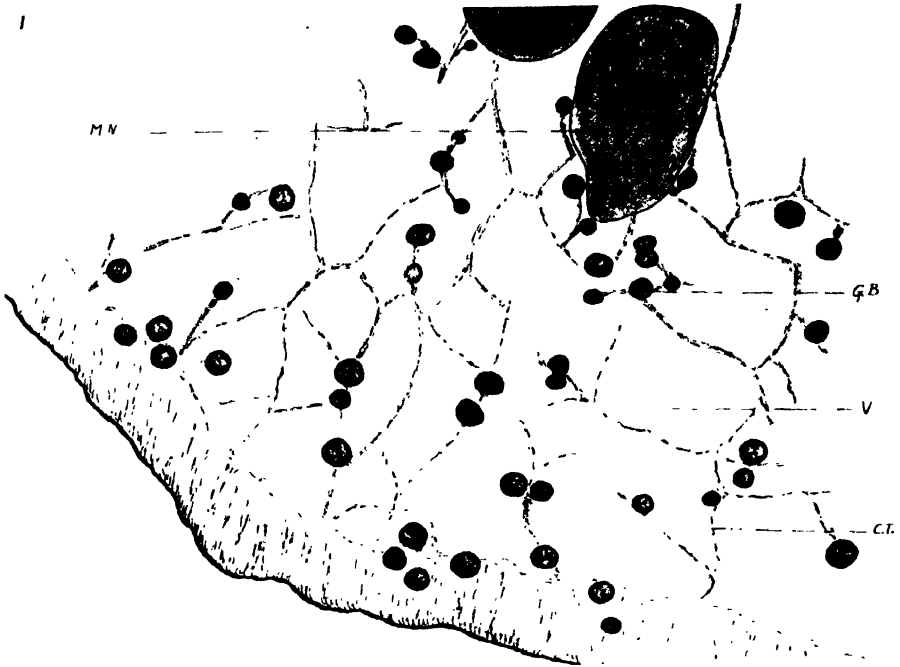


FIG. 1.



FIG. 2.

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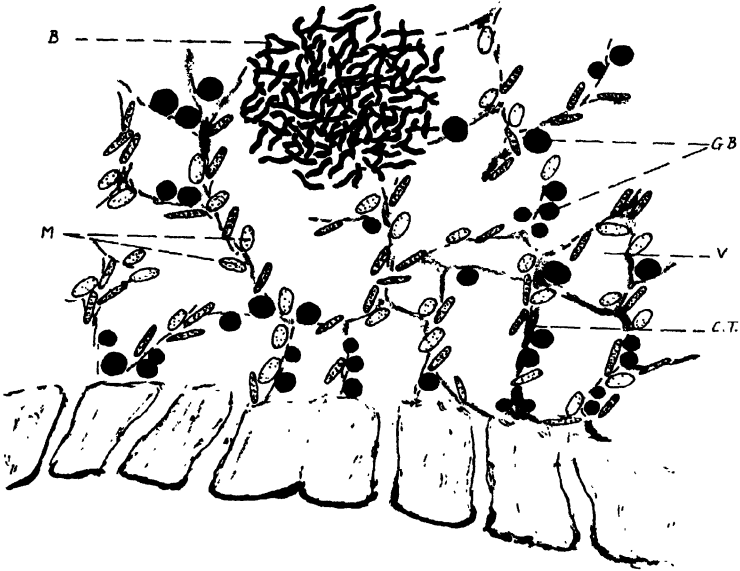


FIG. 3.

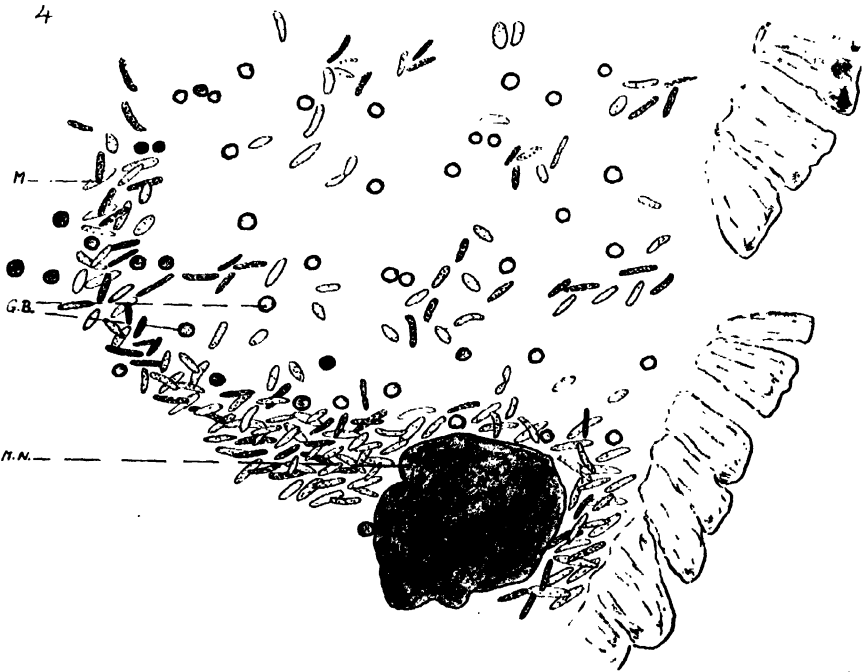


FIG. 4.

and the former that they are composed of an osmiophile membrane enclosing a, perhaps, liquid osmiophobe medulla. This latter speculation would more nearly fit in with the recently developed conception of one function of the Golgi apparatus, namely “. . . to concentrate by partial dehydration the secretory materials originating either from the ground cytoplasm or from mitochondria . . .” (Gatenby, 1937). Where no post-osmication has taken place after Champy fixation, the brown-black granules are slightly smaller than those revealed by the Kolatchew method. This only means that with post-osmication they have become swollen by the osmic acid or appear larger due to the heavy osmic impregnation.

In no case was the wall of the contractile vacuole blackened either after osmic or silver impregnation.

Mitochondria.—These bodies were apparent in Kolatchew preparations which had been bleached and subsequently treated with iron alum hæma-

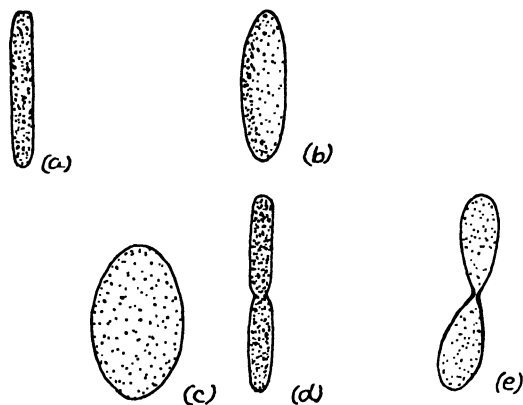


FIG. 1.—(a, b, c).—Various aspects of the mitochondria. (d, e).—Division stages in the mitochondria.

toxylin or with acid fuchsin and methyl green. They appeared red after the fuchsin and blue-black after the hæmatoxylin. They were also shown after Champy and Regaud fixation when stained by the above two methods and after Da Fano together with iron alum hæmatoxylin. The structure of these bodies is especially well shown in some Champy and acid fuchsin preparations, in which they take up the fuchsin. They are discoidal; when seen in face view they are somewhat ellipsoidal; and in side view they have the form of rods. All stages from the rod to the ellipse have been observed (Plate II, fig. 4, and text-fig. 1). Several of these views can be seen on a single trabecula of protoplasm, therefore they must be all different aspects of the same body. Further, it was noticed that in acid fuchsin and iron alum hæmatoxylin preparations, the rod-view showed much deeper staining than did the face-view, an observation which is in agreement with the idea that the rod-like form is only the edge of the ellipse. In no preparations were completely

spherical mitochondria seen. Their number is very much greater than that of the Golgi spheres, and their position, like the latter, is on the protoplasmic meshes. Division stages were apparent in some Champy-acid fuchsin preparations. Dividing individuals were somewhat more elongated than the others, and showed a constriction across the middle (Plate II, fig. 4, and text-fig. 1). The mitochondria are the largest inclusions present in the animal, with the exception of sections of the macronucleus and the food vacuoles. They are approximately $1\frac{1}{2}\mu$ long, whereas the Golgi bodies vary from $\frac{3}{4}$ – $1\frac{1}{4}\mu$ in diameter.

The mitochondria stained up in iron alum hæmatoxylin after Bouin's fluid, when the time of fixation was only 1 hour and insufficient to dissolve out these bodies. However, after fixation overnight in Bouin and subsequent staining, the mitochondria were not revealed.

Bacteria.—These were very well demonstrated in Kolatchew preparations which had been bleached and stained in iron alum hæmatoxylin. They were confined to the food vacuoles, and were of the vibrio type, possessing a single turn. This distinguishes them at once from the mitochondria and, further, they were thinner than the rod-view of the latter. They had not the characteristic blue-black colour of the mitochondria, but a rather more intense black (Plate II, fig. 3).

Microchemical Tests.—Several of the microchemical tests recommended in the "Microtometist's Vade-Mecum" and "Biological Laboratory Technique" were tried. No glycogen was revealed by the iodine gum method or by Best's carmine. No sudanophile fat was shown by the Sudan IV test; the Nile Blue sulphate test also gave negative results, although the food vacuoles took the blue stain after 10 minutes. The volutin test was also tried. In this case many fine granules within the food vacuoles were stained a deep purple-blue. While these are not thought to be volutin granules, the exact chemical nature of them is unknown. The vitamin C test gave negative results, as also did the Schultz cholesterol test.

III. *Effects of Centrifuging*.—When the animals were centrifuged at top speed in the electrical centrifuge for 30 to 45 minutes, distinct effects were obtained.

Neutral Red Bodies.—As previously mentioned, the bodies stained by neutral red were not affected by the centrifugal force. It is concluded that these are the basal granules of the cilia.

Golgi Bodies and Mitochondria.—The mitochondria are clearly the heavier of the two types of inclusion just described. They are displaced to the centrifugal end of the cell and packed in a dense mass in that position before there has been any appreciable effect on the Golgi bodies. This is clearly seen in Champy and Kolatchew-acid fuchsin preparations (Plate III, fig. 6). In all of these the mitochondria are clumped together at the centrifugal pole, whereas the Golgi bodies are unmoved or else are tending to form a layer above the mitochondria, according to the length of time of centrifuging (Plate III, fig. 5). In many cases where the Golgi bodies were just beginning

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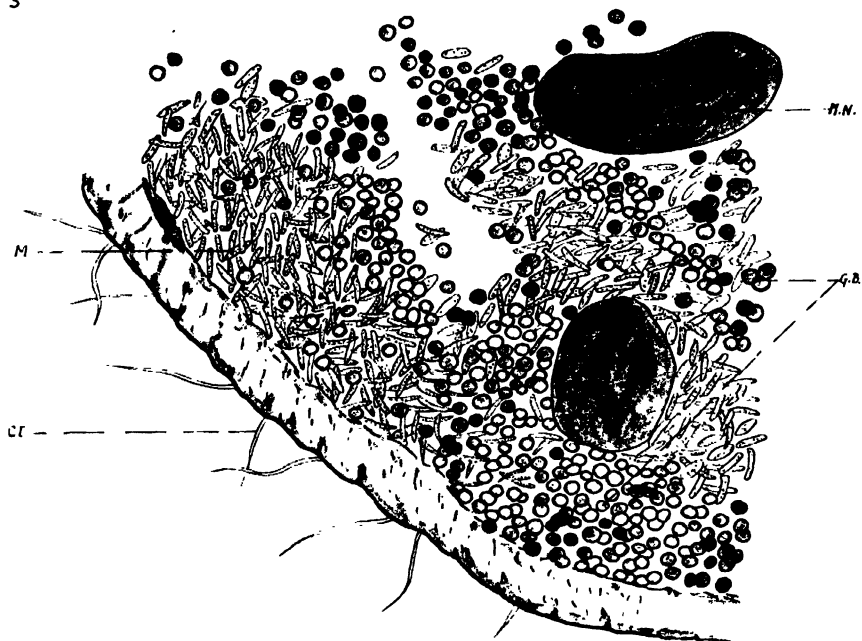


FIG. 5.

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FIG. 6.

to layer, they were seen to do so at the edge of an endoplasmic vacuole or series of coalesced vacuoles. All this fits in with the view that the Golgi bodies are lighter structures than the mitochondria. It was at first thought that the brown-black bodies shown after Champy-fixation and those black spheres revealed by the Kolatchew method were distinct inclusions. But after a thorough re-examination of all the preparations made, both control and centrifuged, it was concluded that the evidence for such a view was too slender, and now it is believed that the bodies are identical, and furthermore they show a similar behaviour on centrifuging.

Effect on the Endoplasm.—After a certain period of centrifuging, the

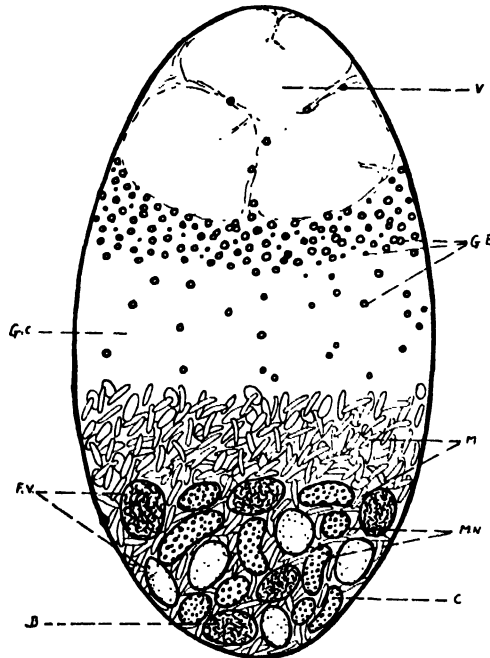


FIG. 2.—Stratification of the Inclusions in *Spirostomum* as the result of Centrifuging. B.—bacteria; C.—chromatin granules; F.V.—food-vacuoles; G.B.—Golgi bodies; G.C.—ground cytoplasm; M.—mitochondria; MN.—macronucleus; V.—vacuoles.

vacuoles coalesce and form one large vacuole at the centripetal end of the animal. The cytoplasmic trabeculae, thus deprived of their fluid contents, mass together and form a layer above the mitochondria. In a centrifuged Weigl preparation, unstained, this layering is well shown, and here the Golgi bodies are still unaffected by the centrifugal force, remaining scattered throughout the section.

Food Vacuoles and Nucleus.—The food vacuoles and the sections of the macronucleus, as the result of centrifuging, become packed at the centrifugal pole of the cell together with the mitochondria.

It appears that the stratification of the cell inclusions, from centripetal to centrifugal end, is as follows (text-fig. 2) :

- (1) Vacuoles.
- (2) Golgi bodies.
- (3) Cytoplasm.
- (4) Mitochondria, food vacuoles, and macronucleus.

DISCUSSION.

Golgi Bodies.—The only known reference to the cytoplasmic bodies of *Spirostomum ambiguum* is that of Hirschler (1924), in which he says "Chez *Spirostomum ambiguum* et *Opalina ranarum* on n'arrive à noircir, par l'acide osmique, qu'une sorte de composants, ayant, eux aussi, la forme de bâtonnets répartis en grand nombre et irrégulièrement dans le plasma," and again ". . . on peut penser que, chez certains Protozoaires (i.e. *Monocystis agilis*, *Monocystis ascidia*), les composés lipoidifères se sont différenciés en mitochondries et en appareil de Golgi ; chez les autres (i.e. *Gregarina polymorpha*, *Gregarina blattarum*, *Spirostomum ambiguum*, *Opalina ranarum*), il s'agit d'un état de choses plus primitif, où les corps lipoidifères n'accusent pas la différenciation mentionnée." Hirschler, in the case of *Spirostomum*, may be describing the mitochondria, which have the appearance of rods when seen in side view, and which are very numerous and scattered throughout the cytoplasm. At the same time, even after three weeks these do not impregnate with osmic acid. But they are shown after osmic fixation, if subsequently stained in iron alum hæmatoxylin, when they have a blue-black appearance in side view and a lighter grey colour in face view. In the present investigation the only bodies to be impregnated by means of osmic acid, even after three weeks' post-osmication, were the Golgi bodies. Hirschler's view that the single type of lipid inclusion present in *Spirostomum* represents both mitochondria and Golgi bodies is disproved by the fact that both types of structure can be demonstrated side by side in the same preparation (Plate I, fig. 2).

In *Blepharisma*, a genus belonging to the *Spirostomidae*, Miss I. Moore (1934) has described small globular Golgi bodies having osmiophile and osmiophobe parts. These were sparsely distributed throughout the endoplasm. This would appear to agree with the writer's conception of the Golgi bodies in *Spirostomum*, but Miss Moore goes on to say, "It was in the hope of demonstrating these structures (i.e. Golgi bodies) vitally that the neutral red technique was employed. . . . Deep red globules corresponding in size and distribution to the osmiophile bodies found in fixed preparations were visible when the endoplasm was barely perceptibly coloured. While it cannot be considered as proved that these neutral red globules represented the osmiophobe centres of the bodies described above, certainly the observed resemblances strongly suggested that possibility." In the present investi-

gation there is no doubt whatsoever that no part of the Golgi bodies takes up the neutral red stain. The red granules demonstrated by this means are very much more numerous than the Golgi bodies.

From what is already known of the protozoan Golgi apparatus, it is justifiable, in the writer's opinion, to extend the homology to the osmiophile granules demonstrated in *Spirostomum*. Evidence from centrifuging shows clearly that they are lighter than the mitochondria; this is in agreement with the observations on the Golgi apparatus of gregarine parasites of *Tenebrio molitor* (Daniels, 1938), and with all modern centrifuging work done on the metazoan Golgi apparatus (Beams, Muliyl, and Gatenby, 1934; Norminton and Gatenby, 1935; Norminton, 1937; Singh, 1938 (in press), etc.), as well as with the behaviour of the osmiophilic platelets, the supposed Golgi homologue, in plant cells (Beams and King, 1935; R. Jones, 1938).

As is the case in the present work, the silver methods of Aoyama, Da Fano, and Cajal are as a general rule ineffective in the demonstration of the Golgi bodies of Protozoa.

From the point of view of Nassonow's contractile vacuole-Golgi apparatus homology for Protozoa, it is interesting to find such forms as *Spirostomum* and *Blepharisma* in which Golgi bodies distinct from the contractile vacuole are demonstrated. As far as the writer is aware, these are the only two Protozoa in which such a case has been described. In neither of these ciliates is the wall of the contractile vacuole osmiophilic.

Mitochondria.—As mentioned earlier, these inclusions are heavier than the Golgi bodies, and whereas the latter are scarcely affected after thirty minutes in the electrical centrifuge, the former are packed in a dense mass at the centrifugal end of the animal. This is the usual position taken up by the mitochondria after centrifuging, except where paraglycogen, glycogen, plastids, starch grains, etc., occur. These are all heavier than the mitochondria, which then form a layer just above these various bodies.

The form of the mitochondria in *Spirostomum* is interesting, being, as they are, discoidal bodies. The only other known case of discoidal mitochondria in either Protozoa or Metazoa occurs in the spermatogenesis of the Indian scorpion *Palamnæus bengalensis* (Gatenby and Bhattacharya, 1924). In this case, however, the discoidal forms found in the spermatocytes later swell up and become spherical, so that the resulting spermatids have from five to twelve mitochondrial spheres. In *Spirostomum* the mitochondria when seen in face view were never completely spherical, but always more or less ellipsoidal. In some Champy-acid fuchsin preparations stages in division of the individual mitochondria were observed. The process seems to take place by a kind of transverse binary fission; a similar process is described by Gatenby and Bhattacharya in *Palamnæus* and by Miss Jones (1938) in the chondriome of *Elodea*.

Miss I. Moore does not describe mitochondria in *Blepharisma*, but then she was really only concerned with the morphology of the contractile vacuole and not with the cytoplasmic equipment of the animal. Among ciliates the

mitochondria have been described as : rods and granules in *Paramecium* (Brown, 1936) ; fine granules in *Opalina* (Patten, 1932) ; short rod-like bodies in *Opalina* (Richardson and Horning, 1931). Here in *Spirostomum* there is a further type, discoidal mitochondria.

The existing knowledge on ciliates is still in a confused state and requires further investigation. It is clear that Nassonow's hypothesis cannot be accepted as it stands ; the presence of Golgi bodies distinct from the contractile vacuole (*Spirostomum* and *Blepharisma*) is against such a view. In *Paramecium* it would appear that the osmiophile walls of the canals of the contractile vacuole are the homologue of the Golgi apparatus of higher forms, as in this particular ciliate no other convincing Golgi apparatus has been shown. This would be in agreement with the findings of Sigot and of Patten and Beams in *Euglena* and of Gatenby and Singh in *Copromonas*, among the Flagellata. No Golgi bodies have been revealed in *Nyctotherus*, and in *Opalina* Miss Patten (1932) has described bodies shown after Da Fano technique which she suggests may be Golgi bodies. Much faith cannot be placed in this view owing to the unsatisfactory behaviour of silver methods with the Protozoa.

SUMMARY.

1. It was found impossible to ultracentrifuge *Spirostomum ambiguum* owing to the extremely vacuolated nature of the endoplasm. Hence the electrical centrifuge was employed throughout.

2. As the result of centrifuging, the stratification of the cytoplasmic elements, on the basis of differences in specific gravity, is considered to be, from centripetal to centrifugal pole, as follows :

- (a) vacuoles
- (b) Golgi bodies
- (c) cytoplasm
- (d) mitochondria, macronucleus and food vacuoles.

3. The neutral red bodies were unaffected by the centrifugal force. They are believed to be the basal granules of the cilia. Neutral red did not stain any portion of the Golgi bodies.

4. Golgi bodies are present. They are spherical granules which impregnate with osmic acid, but are not revealed after the silver techniques. They are thought to have an osmiophile membrane surrounding an osmiophobe medulla. After prolonged impregnation the latter becomes masked and the whole granule appears uniformly blackened.

5. Mitochondria are present and in much greater number than the Golgi bodies. They are discoidal, appearing as deeply staining rods when seen in edge view and somewhat ellipsoidal and more lightly staining in face view.

6. No glycogen, paraglycogen, sudanophile fat, vitamin C, volutin, or cholesterol has been revealed.

7. Bacteria of the vibrio type are present in the food vacuoles, and are easily distinguishable from the mitochondria.

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DESCRIPTION OF PLATES.

All drawings were done by means of a camera lucida.

Lettering: B—bacteria in food vacuole; CI.—cilia; C.T.—cytoplasmic trabeculæ G.B.—Golgi bodies; M.—mitochondria; MN.—macronucleus; V.—vacuoles.

FIG. 1.—Kolatchew preparation, unstained; uncentrifuged.

FIG. 2.—Kolatchew preparation, stained with acid fuchsin; uncentrifuged.

FIG. 3.—Kolatchew preparation, stained with iron alum hæmatoxylin; uncentrifuged.

FIGS. 4 and 5.—Champhy preparations, stained with acid fuchsin; centrifuged.

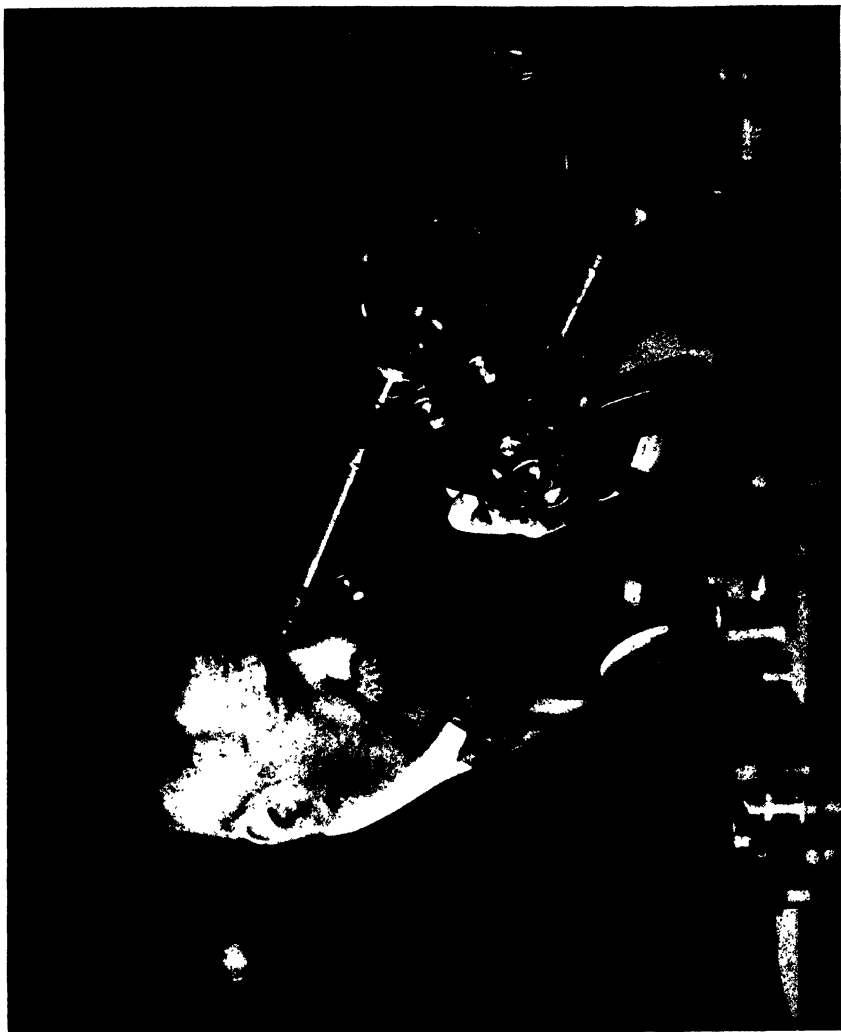
FIG. 6.—Kolatchew preparation, stained with acid fuchsin; centrifuged.

OBITUARY

EDWARD MILLES NELSON.

(1851-1938)

IN the passing of Edward Milles Nelson, the Society loses one of its greatest Past Presidents (1897-8-9) and the pioneer of modern microscopical observational technique, although probably few of the younger present-day users of the microscope are aware of the debt they owe to Nelson's untiring efforts in the cause of truly effective observational methods, carried out unflinchingly in face of the most determined opposition on the part of a host of influential opponents, even including the great Abbe himself. At the present day it is hard to realize the extremely bitter controversy that raged at the time between the upholders of Abbe's dictum of the necessity of a small (pin-hole) stop in the sub-stage condenser as being the ideal condition for attaining the best performance of an apochromatic object-glass of large numerical aperture, as opposed to Nelson's contrary contention that a large aplanatic illuminating cone was essential. The writer recollects that when he purchased his first oil-immersion object-glass in 1887, the optician remarked "of course you will use it with the smallest stop in your Abbe condenser." About this time the position became so acute that the Society refused to publish papers controverting any of Abbe's dicta, and this decision led to Nelson's reading at the Quekett Microscopical Club one of the most valuable papers he ever wrote: "The Substage Condenser: Its History, Construction and Management, and its Effect Theoretically Considered" (*Journal of the Q.M.C.*, Vol. IV., Ser. II., p. 116, No. 27, July 1890). Now that the calm has succeeded the storm, and no serious opposition exists to the views expressed therein, it seems strange that such an able and carefully thought-out communication, together with others of scarcely less importance, were regarded as inadmissible by the senior Society as then represented. It is a fact that the most strenuous part of Nelson's life-work consisted of correcting the harmful observational methods then upheld in consequence of erroneous deductions based on Abbe's celebrated "Diffraction Theory of Microscopical Vision" and for long upheld by Abbe himself in numerous papers communicated to the Society. Nelson, on the other hand, brilliantly demonstrated the practical efficiency of his method of "Critical Illumination" by effecting many discoveries of difficult, previously unknown, diatomic and other structures requiring the perfection of optical and instrumental equipment to reveal. The esteem in which Nelson was held during his three



EDWARD MILLES NELSON, F.R.M.S.
1851—1938.

years' Presidency of the Society must have convinced him that his teaching had not been in vain. He was asked to be President for a fourth term, but did not accept as he had decided to live in the country for reasons of health. He had previously occupied the Presidential Chair of the Quekett Microscopical Club for three successive years (1893-4-5), which Club elected him an Honorary member so recently as in January 1928. His papers and notes to the Club numbered over 100.

Possessing ample private means and considerable mathematical ability, while quite a young man Nelson devoted himself to a life of constant hard work on the theory and practice of the microscope without thought of gain, working at the instrument not only throughout the day, but also often into the early morning hours—at high-power critical photomicrography carried on in an underground cellar converted for the purpose—so as to avoid all chance of tremor when traffic had ceased to pass his then residence in West End Lane, Hampstead. He used to declare that it was not possible to obtain satisfactory photomicrographic results in London until well past midnight. Although comfortable in appearance, the underground chamber in which he thus worked frequently throughout the greater part of the night may have induced the severe rheumatic troubles which attacked him at that time and from which he subsequently suffered throughout his life. The wonderful photographs of difficult, and hitherto unknown, diatomic and other minute structures there secured were far in advance of anything previously accomplished, but were clearly paid for by permanently impaired health. In spite of this disability, during a period of over twenty years Nelson regularly carried his No. 1 Powell microscope in one hand, and a paraffin lamp in the other, to practically every meeting of R.M.S. and Q.M.C. in order to demonstrate his methods and results. Thus in 1882 he exhibited at the R.M.S. Nobert's 19th band resolved for the first time in England.

The 1891 Edition of "*Carpenter*," edited by Dr. Dallinger, was indebted to Nelson for its first new six chapters, for the fine photomicrographs reproduced therein, and for 150 diagrams; although this is not clearly stated in the work, it is a fact. Nelson's therein exposition of the Abbe "*Diffraction Theory of Microscopical Vision*" was submitted by Dallinger to Abbe, who replied, "I feel the greatest satisfaction in seeing my views represented in the book so extensively and intensively." Nelson's only reward for months of hard, unselfish toil in the interests of microscopy consisted in a complimentary copy of the book, nor was anything more expected, the sole object being that others should benefit by his vast experience.

Although Nelson's chief interest and work concerned the practice and theory of the microscope, it was not entirely confined to it. In 1893 he privately published a little book on "*The Theory of Telescopic Vision*." Many experiments were carried out with moderate-sized telescopes, and these aroused the interest of the late Colonel Gifford, of Chard, who, encouraged and guided by Nelson, computed apochromatic telescope object-glasses of most perfect correction and short focal length ratio. The writer has one of

these telescopes, made by Hilger, consisting of a triple object-glass of $8\frac{1}{2}$ inches clear aperture and of 30 inches focus. The images afforded by this instrument on the most trying test objects are perfectly colour corrected and absolutely sharp under the highest eyepieces. Another of Colonel Gifford's triple object-glasses was tested at the National Physical Laboratory and was certified as superior in performance to their standard apochromatic objective. During the Great War over 100 Gifford $2\frac{1}{4}$ -inch telescopes were presented by him to the army and used by our artillery.

Nelson's ever-active mind never rested. When on holiday in Shetland he exhaustively surveyed and studied the prehistoric stone circle at Hestingsgarth (lat. $59^{\circ} 53' 40''$ N., long. $1^{\circ} 18' 30''$ W.), with especial reference to the unit of measurement employed by its constructors. This led to a prolonged and intensive study of other British stone circles, and the subsequent private publication of "The Cult of the Circle Builders." The first edition of this work was printed in 1909 and a second enlarged issue in 1911. On this subject, as on others, Nelson did not hesitate to express and uphold his views fearlessly, even when some of his findings, the outcome of prolonged, perfectly independent investigations, happened to run counter to the dicta of accepted authority.

During very many years Nelson was regarded by most working microscopists as the last court of appeal in all doubtful optical problems connected with the instrument, so that on most days of the week the post brought to him packets of object-glasses and other appliances for his verdict, often from people with whom he was not personally acquainted. Many hours were freely given to careful tests and reports, as a consequence of which not a few research workers were enabled to rest assured that their equipment lacked nothing in efficiency. His perfectly impartial findings were regarded with respect by opticians. Decisions were expressed in a decided way, without ambiguity. Thus when the Abbe-Zeiss apochromats were introduced in 1886 and some leading microscopists hesitated in pronouncing a definite opinion regarding their merits, Nelson at once pronounced these new object-glasses and compensated eyepieces to be far in advance of anything yet produced. It is in the writer's recollection that even Dr. Dallinger for a time maintained that the advance in the defining power of the apochromats was principally due to the compensated eyepieces supplied with them.

Nelson was, above all, a typical gentleman of an age that is perhaps passing away, deeply but unostentatiously religious and intolerant of pretence of any kind. He had read the Bible through three times from beginning to end and a Greek Testament was always at his bedside, from which he read a chapter every morning. His passing leaves a sad blank in the lives of many whom he helped and guided, none more so than that of the writer, who was privileged with his kind friendship during some forty years.

Nelson's communications to the Society started in 1881 and terminated in 1914, upwards of 193 papers and notes in all. The early notes in 1881 dealt with the use of a "centring nose-piece as substage" and the "Resolution

of *Surirella gemma* by Direct Light." In 1882 he exhibited a coccus with flagellum and the resolution of Nobeit's 19th band. In 1885 the flagellum of the cholera bacillus was exhibited, and from that period there were few high-power objects of interest at the moment that were not shown by Nelson at the meetings he so regularly attended with his famous No. 1 Powell microscope. His most important papers dealt exhaustively with the theory and practice of the microscope, and he will be chiefly remembered as the founder of critical observational methods in face of fierce opposition, the practical efficiency of which his many discoveries of difficult structures and his beautiful photomicrographs amply served to demonstrate.

The annexed photograph, taken by the writer in 1910, shows Nelson at work in his study at Beckington Castle. The Powell No. 1 is, as usual, pointed direct to the paraffin lamp of his own design. This was eventually adopted as a standard model. The original is now in the old Ashmolean Museum at Oxford. Practically all Nelson's refined visual observational discoveries of elusive structures were accomplished by the aid of this paraffin lamp.

A. A. C. E. M.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

A New Method of Fixing Celloidin Sections in Series to Glass Slides.—G. LEVI ("Eine neue Methode zur Befestigung der Zelloidin-Serienschnitte an Gläsern," *Z. Wiss. Mikr.*, 1938, **54**, 406-8). Sections are arranged on the glass so that their edges are touching; they are kept moist with 96 p.c. alcohol, covered with a square of clean paper, and pressed down quickly. The paper is removed and the slide, before it has time to dry, is passed into a mixture of absolute alcohol and ether 1 : 4; the time of immersion varying between 10-20 seconds for large and 1 second for very small sections. Sections are then returned to 70 p.c. alcohol to reharden the celloidin, then to water, stained, and mounted. G. M. F.

Cooling the Knife of Freezing Microtomes.—S. ZETHRAEUS ("Modifikation der Schultz-Braunsschen Gefrierschnittmethode," *Z. Wiss. Mikr.*, 1938, **54**, 408-11). To keep the knife cool a brass box shaped to fit it tightly is applied to the blade and filled with a mixture of ether and CO₂ snow, 100 c.c. of the mixture being sufficient to keep the blade frosted for about 20 minutes. If a longer time is necessary dry ice replaces the CO₂ snow. G. M. F.

A Method of Flattening Celloidin-Paraffin Sections.—E. VON HERRATH ("Ein einfaches Verfahren, dicke Zelloidin-Paraffinschnitte zu strecken und aufzukleben," *Z. Wiss. Mikr.*, 1938, **54**, 413-4). Thick sections which do not spread satisfactorily or adhere to the glass can be induced to do so by unrolling the curled sections with two brushes on a slide previously smeared with albumin-water and covered with distilled water. Sections are held down with a strip of coated paper as big as the slide. The paper is pressed down with the thumb on the section, which is again wetted with distilled water and placed in an incubator at 40-45° C. for 24 hours to loosen the paper. The fixative is coagulated by holding over a flame. G. M. F.

Differential Staining with Methyl Green of the Frog's Pancreas, with Special Demonstration of the Zymogen Granules.—J. KREMER ("Eine einfache und empfehlenswerte Methylgründoppelfärbung des Kaltblüterpankreas mit besonderer Hervorhebung der Zymogengranule," *Z. Wiss. Mikr.*, 1938, **54**, 419-21). Frog pancreas is fixed in Zenker's fluid, passed into potassium iodide, iodine alcohol, embedded in paraffin, and sections are cut. Sections are taken down to water, treated with sodium thiosulphate, and placed in 4 p.c. iron alum for 12 hours. Sections are then immersed for 12 hours in methyl green (Grübler) 1 gm., phenol 0.25 gm., distilled water 100 c.c., rinsed in water, blotted, dehydrated,

and mounted. The zymogen granules stain blue to red violet, while nuclei and nucleoli are green. The differential staining is due to the presence of methyl violet as an impurity in the methyl green. G. M. F.

Staining with Hæmalum, Erythrosin, Orange G.—J. MATHIS ("Schnittfärbung mit Hämalaun-Erythrosin-Orange, *Z. Wiss. Mikr.*, 1938, **54**, 428-9). After fixation in any of the usual fixatives stain intensely in Mayer's acid hæmalum and wash well in tap water. After immersion in 70 p.c. alcohol overstain with erythrosin or cosin, then rapidly transfer to orange G solution (sat. aq. orange G 10 drops, 96 p.c. 10 c.c.). Differentiation, which usually requires about 30 seconds, can be controlled under the microscope; rinse quickly in 96 p.c. alcohol and flatten with a brush moistened by the alcohol. G. M. F.

Iron in the Liver and Spleen of Cold Blood Animals.—J. KREMER ("Zum mikrochemischen Eisennachweis im Leber und Milzpigment der Kaltblüter," *Z. Wiss. Mikr.*, 1938, **54**, 529-32). In the spleen and liver of hibernating amphibia and reptiles are two pigments, both of which apparently contain iron. The iron can be demonstrated by cutting 10μ paraffin sections, bleaching in 3-5 p.c. hydrogen-peroxide for 3-5 days, washing thoroughly in distilled water, and transferring to either potassium ferrocyanide and hydrochloric acid or potassium ferricyanide and hydrochloric acid, preceded by immersion in ammonium sulphide. Both pigments show up as blue granules. G. M. F.

A Lamp for Critical Illumination.—J. GORDON CARLSON ("An Inexpensive Microscope Lamp for Critical Illumination, *Stain Technol.*, 1938, **13**, 97-100, 1 text-fig.). A microscope lamp with light of adjustable intensity which will afford critical illumination of a quality suitable for the most exacting cytological work is described and illustrated: the cost is just under £2. The essential parts needed are a 50 c.p. 6-8 v. single-filament motor headlight bulb, a radio power transformer, radio "potentiometer," and a simple plano-convex lens. A ground glass is not used with 4 and 2 mm. objectives, a solid source of light being obtained by placing the bulb so that one filament coil is directly behind the other. This light source is brought to a focus by a condensing lens at a field diaphragm and this image is projected by the microscope condenser into the plane of focus of the microscope. G. M. F.

A Modification of the Mallory Triple Stain for the Pituitary.—T. MAXWELL, JR. ("A Controllable Differential Stain for the Hypophysis by Adaptation of the Mallory Triple Stain," *Stain Technol.*, 1938, **13**, 93-6). The gland is removed as quickly as possible and fixed for not longer than 6 hours in Zenker formol in which the 40 p.c. formalin stock solution is neutralized with magnesium carbonate and added to the mercuric chloride-potassium bichromate solution just before use in a proportion of 5:95. The tissue is rinsed in distilled water and transferred to 30 p.c. alcohol containing a few drops of a saturated solution of iodine in aqueous potassium iodide over night, gradually dehydrated, and cleared in cedar oil and infiltrated with a paraffin mixture consisting of paraffin, m.p. 56-8° C., 100 gm., rubber paraffin 4-5 gm., bayberry wax 5-10 gm., beeswax 1 gm. Sections are cut at 3-5 μ , passed to distilled water, placed in a few drops of potassium iodide, iodine solution in 50 p.c. alcohol, and stained for 30 minutes in 1 p.c. acid fuchsin. Sections are then rinsed in tap water and differentiated in a weak ammonia solution (1 drop of 28 p.c. NH_4OH to 200 c.c. of water). When differentiation is complete transfer to 0.5 p.c. phosphomolybdic acid solution for three minutes, first stopping the differentiation with an 0.1 p.c. HCl solution and then rinsing in distilled water.

Stain for 1 hour in a solution of water soluble anilin blue 1 gm., orange G 2 gm., phosphomolybdic acid (yellow crystals) 1 gm., and distilled water 100 c.c. Rinse in distilled water containing a few c.c.s. of the stain. Differentiate in 95 p.c. alcohol, absolute alcohol; clear in a mixture of 30 p.c. cedar oil, 40 p.c. oil of thyme, 15 p.c. absolute alcohol, and 51 p.c. xylol. Finally transfer to xylol and mount. G. M. F.

Wright's Stain for Reticulocytes.—S. F. KITCHEN ("The Demonstration of Reticulocytes with Wright's Stain," *Stain Technol.*, 1938, 13, 107–91). Reticulocytes may be demonstrated by means of Wright's stain as readily as by cresyl blue. A 0.3 p.c. solution of the stain in absolute acetone-free methyl alcohol is used and a thin even film is spread on a glass slide. A small drop of blood is placed on a cover slip, which is then inverted on the slide and the preparation sealed with vaseline. Dry slide preparations are made by spreading a moderately heavy film of the 0.3 p.c. dye solution on a glass slide and when this is dry, superimposing a blood smear thin enough to allow the individual cells to be separated. Wright's stain is then used as a counterstain in the usual way. In these preparations the reticulum usually appeared as granules varying in size and number. G. M. F.

Differentiation of Secretory Cells in the Pars Nervosa of the Pituitary.—M. R. LEWIS and C. H. MILLER ("Differentiation of the Secretory Cells of the *pars nervosa* of the Hypophysis cerebri," *Stain Technol.*, 1938, 13, 111–4). By means of the technique described it is possible to obtain permanent preparations of the two types of granular cells in the *pars nervosa* of the hypophysis as they are seen in fresh tissues and in tissue cultures. Tissues are fixed with one change of fixing fluid for from 12 to 24 hours in a solution of 3 p.c. potassium bichromate in water 2 parts and a half-saturated solution of corrosive sublimate in 95 p.c. alcohol 1 part. Pass up to 70 p.c. alcohol to which a few drops of iodine are added. Change daily till the solution retains its colour. Dioxan, three changes each within 8–24 hours. Dioxan with a small amount of paraffin; paraffin, using four changes. Sections are cut at 5 μ ; remove paraffin with xylol and pass down to water. Sections are stained in a 0.25 p.c. aqueous solution of acid fuchsin for 30 minutes, then directly into Mallory's stain for 1–24 hours (distilled water 100 c.c., aniline blue 0.5 gm., orange G 2.0 gm., and phosphotungstic acid 1.0 gm. Pass directly into 95 p.c. alcohol; several changes till no more colour is given off. Absolute alcohol, xylol, mount in Canada balsam. G. M. F.

Modification of Masson Trichrome Technique.—J. GOLDNER ("A Modification of the Masson Trichrome Technique for Routine Laboratory Purposes," *Amer. J. Path.*, 1938, 14, 237–43). The following modification can be carried through in from 20 to 40 minutes. Paraffin sections taken down to water are stained in Hansen's iron hæmatoxylin for 1–5 minutes. The dye may be used pure or acidified with 2 parts of a 2 p.c. aqueous sulphuric acid to 8 parts of the dye. If acidulated the dye will not overstain the tissue; it may be used repeatedly, but must be filtered before use. It keeps approximately 6 weeks in ordinary use. Sections, after staining, are washed at the tap as long as yellowish-brown clouds come off in the water. After 5 minutes the nuclei should be a rich black. Stain in Masson's fuchsin-ponceau mixture, diluted ten times with water acidulated 1 in 500 with acetic acid for 5 minutes or more. Rinse in acidulated distilled water; treat for from 15 seconds to 30 minutes with phosphotungstic acid orange G; repeat rinsing with distilled water; stain for 5 minutes in Masson's light green solution diluted ten times with acidulated water; rinse for 5 minutes in acidulated distilled water; dehydrate in ascending alcohols, clear in xylol, and mount in

balsam. The nuclei are black to brownish-black; the cytoplasm is brick red; red blood corpuscles are yellowish-vermillion to orange; collagen and mucus bluish-green. Other structures appear in various shades of grey superimposed upon the reddish background. G. M. F.

A Modification of Hæmatoxylin Eosin Staining.—A. A. KRAJIAN ("A Rapid and Economical Method for Staining Routine Tissue Sections with Hæmatoxylin and Eosin," *Arch. Path.*, 1938, **25**, 376-7). To overcome the difficulties of staining with eosin and subsequent dehydration, dehydration is carried out before counter-staining with eosin dissolved in carbol-xylene "eosinol." Subsequent treatment does not lead to further decolorization. Eosinol is made by dissolving 5 gm. of aqueous eosin in 10 c.c. of distilled water, precipitating it by adding 10 c.c. of glacial acetic acid, and mixing with a glass rod. The resulting coagulum is incubated at 56° C. for from 12 to 16 hours or till the water has evaporated. This dehydrated acid-eosin is dissolved in 10 c.c. of absolute alcohol and 20 c.c. of acetone, stirring with a glass rod for several minutes. The undissolved portion is allowed to settle to the bottom of the container and is discarded, while the clear supernatant fluid is removed and is added to 1,500 c.c. of carbolxylene (1 part pure phenol crystals in 3 parts of neutral xylol). Some precipitate is formed: the clear portion is eosinol, which keeps indefinitely. After staining and blueing in alum-hæmatoxylin (Harris: Delafield) sections are dehydrated in 95 p.c. and absolute alcohol and then counterstained and partially cleared in eosinol for from 10 to 30 seconds, depending on the strength of the solution: carbolxylene for 3 minutes and three changes of xylene, each applied for 2 minutes. Sections are mounted in gum dammar (a saturated solution of gum dammar in neutral xylene). G. M. F.

Standardizing the Iodine Stain for Intestinal Protozoa.—J. S. D'ANTONI ("Standardization of the Iodine Stain for Wet Preparations of Intestinal Protozoa," *Amer. J. trop. Med.*, 1937, **17**, 79-84). Standardized iodine solutions are recommended for obtaining uniform results in the examination of intestinal protozoa; 1.5 gm. of powdered iodine crystals are added to 100 c.c. of a 1 p.c. standardized potassium iodide solution. After standing for 4 days the solution is filtered. G. M. F.

A Spore Stain.—G. K. ASHBY ("Simplified Schaeffer Spore Stain," *Science*, 1938, **87**, 443). The following modifications have simplified the procedure. A tin can or beaker of proper diameter or a metal tray about 3 inches deep and 2 inches wide, on an asbestos centred wire gauze, is used to heat the slides. Smears, prepared from spore suspensions, are dried for staining by laying the slide on the table-top near the base of the burner used for heating the steam bath. Dried slides are placed across the steam bath until definite droplets of water collect on the bottom of the slide. The slides are then flooded with 5 p.c. aqueous malachite green and left on the steam bath for 1 minute. Stained slides are removed and dropped into cold water, thoroughly rinsed, and while still wet, counterstained with 0.5 p.c. aqueous safranin for 30 seconds and again rinsed in cool water. Spores stain green, vegetative cells red. G. M. F.

Fixing and Staining Earthworms.—E. C. COCKE ("A Method for Fixing and Staining Earthworms," *Science*, 1938, **87**, 443-4). The dirt is rinsed off earthworms, which are placed in a covered dish. In the dish are placed equal parts of corn meal and powdered agar and some finely chopped lettuce. The worms are transferred to clean dishes with fresh food every day for 3 days. By this time the alimentary tract should be free from all dirt and grit. The worms are fixed by

cutting up into lengths 0.75 inches long and placing for 12 hours in Allen's B-15 at 50° C., rinsed, and taken up, to absolute alcohol, leaving in each alcohol for 1 hour. They are then passed through 1 part chloroform to 3 parts 100 p.c. alcohol for 1 hour, 1 part chloroform to 1 part alcohol, 3 parts chloroform to 1 part alcohol, and pure chloroform each for 1 hour. The chloroform is saturated with paraffin, left 12 hours, more paraffin added, and placed in an oven at 58° C. for 12 hours. The liquid is poured off, melted paraffin added, and left in the oven for 48 hours, then embedded and sectioned at 12 μ . Delafield's hæmatoxylin is applied to the sections for 10–30 minutes; the sections are then washed in water, differentiated in acid alcohol till deep pink, then washed in ammonia alcohol till light blue.

G. M. F.

Histological Methods for Brain Tumours.—N. C. FOOT ("Useful Methods for the Routine Examination of Brain Tumours," *Amer. J. Path.*, 1938, **14**, 245–52, 1 pl.). Material is fixed in formalin-alcohol, Bouin's fluid, Cajal's formalin-ammonium bromide, and Zenker's fluid. Goldner's modification of the Masson trichrome technique is recommended, also silver impregnation.

G. M. F.

Staining Acid-Fast Bacilli.—G. L. FITE ("The Staining of Acid-fast Bacilli in Paraffin Sections," *Amer. J. Path.*, 1938, **14**, 491–507). Acid-fast bacilli are best stained in tissues by fixation in an alcoholic medium, removal of mercuric deposits with iodine followed by alcohol and sodium thiosulphate, and staining in a 1 p.c. solution of new fuchsin in 5 p.c. phenol and 10 p.c. methyl alcohol. If a potassium bichromate fixative is used the period of fixation must be short, the tissue well washed, and the section treated with potassium permanganate and oxalic acid. In tissues fixed for long periods in formaldehyde or decalcifying fluids acid-fast bacilli cannot be demonstrated. To ensure maximal staining sections should be stained after alcohol fixation, at 20° C. for 2–8 hours, at 37° C. for 1–4 hours, at 60° C. for 30 minutes to 2 hours, or at 90° C. for 5 minutes. New fuchsin as a dye is much superior to basic fuchsin.

G. M. F.

Demonstrating Weakly Acid-fast Tubercle Bacteria.—G. G. DE BORD ("Demonstrating Weakly Acid-fast Tubercle Bacteria in Sputum," *Stain Technol.*, 1938, **13**, 101–5). Certain sputa which are negative to the standard staining technique show rods with round polar bodies, or similar bodies without the rod portion when the following technique is used. Smears are stained with steaming Czapelewski's carbol fuchsin for 6–10 minutes, well washed, decolorized in 3 p.c. hydrochloric acid in 70 p.c. ethyl alcohol for approximately 3–5 seconds, counterstained with either an aqueous or alcoholic solution of picric acid. Decolorization is carried to the point where the majority of other bacteria in the smear are decolorized though a small percentage will still show a very faint pink colour.

G. M. F.

The Fixation and Detection of Glycogen.—H. GENDRE ("A propos des précédés de fixation et de détection histologique du glycogène," *Bull. Histol. appl.*, 1937, **14**, 262–4). Tissues are fixed for 15 minutes in the following mixture, saturated solution of picric acid in 90 p.c. alcohol 8 parts, formol 1.5 parts, glacial acetic acid 0.5 parts. Tissues are embedded in paraffin, and sections after taking down to distilled water are placed in distilled water containing 25 drops of an acidified aqueous solution of aniline blue. Sections are counterstained with Lugol's iodine and differentiated in iodized alcohol and mounted in mineral oil. Glycogen stains a mahogany brown.

G. M. F.

A Counterstain for the Gram Technique.—S. A. SCUDDER ("Note on Differential Counterstain for the Gram Technic," *Stain Technol.*, 1938, **13**, 124).

The formula recommended as a Gram counterstain is pyronin yellow (Nat. Aniline Co.) 0.1 gm., methyl green (Nat. Aniline Co., NG-10 and 11 or 13) 0.65 gm., hot-distilled water 99 c.c. ; allow to age for several days and store in brown glass bottles in the dark. This stain can be prepared in bulk and will keep for a long period. In addition to bacteria and ordinary cells, fungal mycelia and spermatozoa may be demonstrated. The head of the sperm cell is clear blue. G. M. F.

Growing, Staining, and Making Permanent Slides of Pollen Tubes, Spores, or Mycelia.—E. H. NEWCOMER ("Procedure for Growing, Staining, and Making Permanent Slides of Pollen Tubes," *Stain Technol.*, 1938, **13**, 89-92, 1 text-fig.). The following procedures are equally satisfactory for germinating spores or studying mycelium: 0.5 gm. of agar and an optimum quantity of sugar are boiled in 25 c.c. of tap water or Hoagland's solution. Cool to 35° C. and add 0.5 gm. of powdered gelatine with stirring. The mixture is smeared in a thin film on a warmed slide and the pollen or other material dusted on. The slides are then placed in a moist chamber for germination. They can be stained supravitaly with Janus green or neutral red or killed when desired in any suitable fluid. Killing for 8 hours or overnight and washing for from 2 to 4 hours in cold running water seems adequate. For staining a crystal violet procedure is recommended.

G. M. F.

Leuco Basic Fuchsin.—L. C. COLEMAN ("Preparation of Leuco Basic Fuchsin for Use in the Feulgen Reaction," *Stain Technol.*, 1938, **13**, 123-4). The following technique can be used for obtaining a colourless leuco basic fuchsin. To 200 c.c. of the solution of basic fuchsin are added 2 gm. of potassium metabisulphite and 10 c.c. of normal hydrochloric acid. After allowing the solution to bleach for 24 hours, 0.5 gm. of Norit is added, shaken for a minute, and then rapidly filtered through coarse filter paper. The resulting solution, which is as clear as water, gives excellent results with the Feulgen technique.

G. M. F.

Collagen, Elastic, and Reticular Fibres in the Skin.—B. JALOWY ("Kollagen, Elastin, und Retikulin der Haut," *Z. Zellforsch. Mikr. Anat.*, 1937, **27**, 667-90). By the following modification of Ortega's method reticular fibres can be differentiated from collagen: tissues are fixed in neutral formalin for 1-2 days, embedded in paraffin, sectioned, and passed down to water. Sections are stained for from 5 to 30 minutes at 30° C. in the following solution: silver nitrate 10 p.c. solution 20 c.c., sodium hydroxide 40 p.c. 20 drops, precipitate washed ten times in distilled water, suspended in 20 c.c. of distilled water, and ammonia added drop by drop till the precipitate dissolves; 100 c.c. of distilled water are added to the supernatant solution, which is stored in the dark till needed. After staining sections are rinsed in distilled water and in ammonia water, then placed in neutral formalin 1:4, washed in running water, dehydrated, and mounted in Canada balsam. The unchanged collagen is yellow or brownish-yellow; the reticular fibres are impregnated with silver.

G. M. F.

Names of Staining Solutions.—H. J. CONN ("Fancy Names for Staining Solutions," *Stain Technol.*, 1938, **13**, 121-2). The practice of giving staining solutions names, such as hæmalum, was begun by Arthur Mayer, about 40 years ago. The practice of selling staining solutions under fancy names and keeping the formula secret is increasing, but can be counteracted by always stating the formula of the dye solution used, except with such well-known dyes as Wright's or Giemsa's stains.

G. M. F.

Cytology.

Chromosome Structure.—R. R. GATES and G. N. PATHAK ("Chromosome Structure," *Nature*, 1938, **142**, 156). Diagrams of chromosomes from the root-tip cells of the saffron *Crocus sativus* during mitosis are shown in which the double structure of the chromosomes is rendered evident by the presence of satellites. By a special method of staining and mordanting the chromatin is stained red and the nucleolar material green. The origin of the nucleolus from the split chromosomes can readily be followed. G. M. F.

A Comparison of Malignant and Non-malignant Nuclei and Nucleoli.—M. E. HAUMEDER ("A Cytologic Comparison of Malignant and Non-malignant Nuclei and Nucleoli," *J. lab. clin. Med.*, 1938, **23**, 1046–52, 4 text-figs.). An enlarged nucleolus is found to be characteristic of the malignant cell. It is said to be present at an early stage in the development of malignancy. G. M. F.

The Cells in Murine Leprosy.—H. PINKERTON and A. W. SELLARDS ("Histological and Cytological Studies of Murine Leprosy," *Amer. J. Path.*, 1938, **14**, 435–42, 1 col. pl.). Lepra cells in murine leprosy are derived largely from mesenchymal cells belonging to the reticuloendothelial system. Exceptionally, however, epithelial cells, specifically those of the epidermis, testicular tubules, and epididymis become distended with lepra bacilli. In infected rats and mice surviving for long periods, tissues of all organs were extensively replaced by non-vacuolated lepra cells distended with bacilli. Kidney tissue contained relatively few of these cells. Non-pathogenic acid-fast bacilli, injected intracerebrally, were taken up by macrophages and polymorphonuclear leucocytes, but disappeared from the lesions in a few weeks. G. M. F.

Protozoa.

Chaos.—S. O. MAST ("Amoeba and Pelomyxa vs Chaos," *Turtox News* (U.S.A.), **16** (3), 1938, [n.p.], 1 pl.). A discussion of the validity and status of the genus and species *Chaos chaos*. Rösel (1755) described an organism to which Linnaeus gave the name *Volvox chaos* in 1760, and *Chaos proteus* in 1767. Schaeffer (1926) maintained that this organism is generically the same as *Amoeba proteus* (Leidy) and specifically the same as *Pelomyxa carolinensis* (Wilson), and that the generic name for both should be *Chaos*. Johnson and Mast (1931) pointed out that Rösel's organism was a mycetozoon and had nothing in common with either *Amoeba* or *Pelomyxa*. Later, Schaeffer (1937) found a "giant amoeba" like *P. carolinensis* which he named *Chaos chaos*. In the present paper it is contended that Rösel's *Chaos* is unidentifiable, and therefore there can be no grounds for including *Amoeba* or *Pelomyxa* in this genus. In view of the similarity of Schaeffer's "giant amoeba" to *P. carolinensis* it should be described as such and not as *C. chaos*. C. A. H.

Size of Amoeba.—S. O. MAST and C. FOWLER ("The Effect of Sodium, Potassium, and Calcium Ions on Changes in Volume of *Amoeba proteus*," *Biol. Bull.*, **74**, 1938, 297–305, 3 figs.). Description of experiments upon the effect of sodium, potassium, and calcium ions in phosphate buffer solutions (0.002M, pH 6.8) on changes in the volume of *Amoeba proteus*. By transferring the amoebæ from Ringer solution into distilled water, and buffer solutions containing metallic cations (Na, K, Ca), lactose solutions, etc., it was shown that the change in volume of the amoebæ is due to the action of monovalent and divalent cations which regulate the rate at which water passes into and out of the body. This is probably due to their effect upon permeability to water. C. A. H.

Contractile Vacuole of *Amœba*.—S. O. MAST ("The Contractile Vacuole in *Amœba proteus* (Leidy)," *Biol. Bull.*, **74**, 1938, 306–13, 1 fig.). The contractile vacuole of *Amœba proteus* is limited by a distinct membrane about 0.5μ thick. Adjoining it on the outside is a differentiated layer of substance in which numerous β granules are embedded. Neither these granules nor the outside layer are involved in the function of the contractile vacuole. The nature of the granules found in the cytoplasm of *amœbæ* is also discussed. C. A. H.

Nutrition of *Amœba*.—S. O. MAST and R. A. FENNELL ("The Relation between Temperature, Salts, Hydrogen Ion Concentration, and Frequency of Ingestion of Food by *Amœba*," *Physiol. Zool.*, **11**, 1938, 1–18, 8 figs.). Observations on *amœbæ* in cultures have shown that their feeding depends upon the condition of the organisms themselves and upon the condition of the environment. Working with *Amœba proteus* and *A. dubia*, the authors have studied the factors influencing the feeding of these *amœbæ*. On the whole, frequency of ingestion was found to vary inversely with the amount of food in the *amœbæ*, but the abundance of food in the medium does not affect the frequency of ingestion. The latter also depends upon the pH of the medium and differs according to the nature of the metallic cation present. It is also dependent upon the concentration of various salts. The relation between temperature, salts, and pH, on the one hand, and the frequency of ingestion of food, on the other, is essentially the same as the relation between these environmental factors and rate of locomotion. C. A. H.

Effect of Light upon Locomotion of *Amœba*.—S. O. MAST and N. STAHLER ("The Relation between Luminous Intensity, Adaptation to Light, and Rate of Locomotion in *Amœba proteus* (Leidy)," *Biol. Bull.*, **73**, 1937, 126–33, 2 figs.). Experiments with *Amœba proteus* showed that its rate of locomotion was correlated with the intensity of the light to which it is exposed and the state of adaptation. In light of any given constant intensity as adaptation to light increases the rate of locomotion increases to a maximum and then remains constant, but in constant light of ascending intensities the time required for adaptation first decreases and then increases, while the rate of locomotion first increases to a maximum and then falls. C. A. H.

Heredity in *Diffugia*.—H. S. JENNINGS ("Formation, Inheritance, and Variation of the Teeth in *Diffugia corona*. A Study of the Morphogenetic Activities of Rhizopod Protoplasm," *J. Exp. Zool.*, **77**, 1937, 287–336, 20 figs.). In *Diffugia corona* the mouth is surrounded by a series of complex teeth, differing in number in various clones and formed at fission. The present study is concerned with the following questions: inheritance and variation in the teeth in normal reproduction; correlation of number of teeth with size of body or of mouth; the effect of altering the mouth and teeth of the parent by operation; factors determining the character and number of teeth. C. A. H.

Light Reactions of *Peranema*.—L. B. SHETTLES ("Response to Light in *Peranema trichophorum* with Special Reference to Dark-adaptation and Light-adaptation," *J. Exp. Zool.*, **77**, 1937, 215–49, 12 figs.). The flagellate *Peranema trichophorum* responds to a rapid increase of illumination by rapid deflection of the body, but if the increase is slow this does not occur. The reaction is therefore a typical shock reaction. There is no indication of a differential response to localized stimulation. Stimulation by light is dependent upon the wave-length as well as upon the intensity. As light- or dark-adaptation increases the sensitivity

to light increases to a maximum, then decreases to a minimum, and afterwards remains nearly constant. The reaction time consists of an exposure period and a latent period, which are dependent upon temperature. C. A. H.

Growth of Flagellates in Thiazole Media.—A. LWOFF and H. DUSI ("Influence de diverses substitutions sur l'activité du thiazol considéré comme facteur de croissance pour quelques flagellés leucophytes," *C. R. Soc. Biol.*, **128**, 1938, 238–41). A detailed study of the effect of various thiazole compounds upon the growth of the flagellates *Polytoma caudatum*, *P. ocellatum*, *Polytomella cæca*, and *Chilomonas paramæcium* in culture, for particulars of which the original should be consulted. C. A. H.

Rôle of Silicon in Flagellate Metabolism.—S. O. MAST and D. M. PACE ("The Effect of Silicon on Growth and Respiration in *Chilomonas paramæcium*," *J. Cell. and Comp. Physiol.*, **10**, 1937, 1–13, 2 figs.). The flagellate *Chilomonas paramæcium* divides 3·5 times a day and lives indefinitely in a solution consisting of NH_4Cl , K_2HPO_4 , MgSO_4 , $\text{NaC}_2\text{H}_3\text{O}_2$, and H_2O . If silicon in optimum concentration ($=0\cdot0000081\text{M}$) is added the rate of growth and the frequency of division increase 24 p.c. In the absence of sulphur division is retarded and death takes place in about three days, but the addition of silicon prolongs the life of the flagellate. This element also causes an increase of the starch content of *Chilomonas*, and an increase in the rate of respiration, but in the absence of sulphur the increase is absent or negligible. The favourable effect of silicon upon the rate of growth and respiration of this flagellate is due to its catalytic action on the synthesis of complex organic compounds. C. A. H.

Mastigophora found in Hertfordshire.—F. W. JANE ("Some Hertfordshire Flagellates," *Trans. Hertfordsh. Nat. Hist. Soc.*, 1938, **20**, 340–51, 2 figs.). A record with brief descriptions, is given of various flagellates collected in Hertfordshire, only those genera and species being noted which have not hitherto been recorded from Britain. C. A. H.

Culture Requirements of Strigomonas.—M. LWOFF ("L'aneurine, facteur de croissance pour les *Strigomonas* (Flagellés Trypanosomides)," *C.R. Soc. Biol.*, **128**, 1938, 241–3). A study of the metabolism of various species of the Trypanosomid flagellate *Strigomonas* in culture. It is shown that the presence of aneurine is indispensable for their growth. C. A. H.

Flagellates from Termites.—H. KIRBY, Jr. ("The Devescovinid Flagellates *Caduecia theobromæ* França, *Pseudodevescovina ramosa* new species and *Macrotrichomonas pulchra* Grassi," *Univ. California Publ. Zool.*, **43**, (1), 1938, 1–40, 6 pls., 3 text-figs.). A revised account is given of *Caduecia theobromæ*, originally described by França, and the data for Grassi's *Macrotrichomonas pulchra* are supplemented and corrected. A description is given of *Pseudodevescovina ramosa* sp.n. from an African termite, *Kaloterms* sp. Particular attention is devoted to the parabasal apparatus and other cytological details and to division of these flagellates. C. A. H.

Cnidosporidia from American Fish.—F. F. BOND ("Cnidosporidia from *Fundulus heteroclitus* Linn.," *Trans. Amer. Micr. Soc.*, **57** (2), 1938, 107–22, 3 pls.). Amongst the cnidosporidia found in the fish *Fundulus heteroclitus*, from Chesapeake Bay and Hudson River, the following new Myxosporidia are described: *Myxosoma subtecalis* sp.n. (from connective tissue of viscera; in fins and surface of brain); *M. hudsonis* sp.n. (fins); *Myxobolus bilineatum* sp.n. (various tissues); *Myxidium*

folium sp.n. (liver); *Sphaerospora renalis* sp.n. (kidney). In addition, observations are recorded on two species of Microsporidia. The use of 5 p.c. phenol solution added to an aqueous smear of the parasites is recommended for the extrusion of the spore filaments. C. A. H.

Non-pathogenicity of Piscine Myxosporidia.—F. F. BOND ("The Doubtful Relationship of Sporozoa to the Ulcers of *Fundulus heteroclitus* (Linn.)," *J. Parasitol.*, **24**, 1938, 207–13). With the view of ascertaining the part played by the myxosporidian parasites, *Myxosoma funduli*, *M. subtecalis*, and *Myxobolus bilineatus*, in the production of sores in their piscine host, *Fundulus heteroclitus*, a series of observations and experiments was conducted, in the course of which the parasites were inoculated into the flesh of the fish. The examination of existing sores never revealed any sporozoa, and the inoculation of parasites likewise produced no lesions, in view of which it is concluded that the Myxosporidia are not concerned in the production of the sores. C. A. H.

Sarcosporidiosis in American Livestock.—I. D. WILSON and R. McDONALD ("Some Notes on Sarcosporidia in Virginia," *J. Parasitol.*, **24**, 1938, 248–9). With the object of establishing the incidence of sarcosporidiosis in the livestock of Virginia, the authors examined sections of the heart muscle from 35 cows, 29 calves, 27 sheep, and 1 horse. The incidence in adult cattle was the highest (31 positive), but none of the calves were infected; 8 sheep harboured parasites and the horse was also positive. The Sarcosporidia from all sources were similar in appearance. C. A. H.

New Gregarine from Gephyrean.—E. R. NOBLE ("A New Gregarine from *Urechis caupo*," *Trans. Amer. Micr. Soc.*, **57** (2), 1938, 142–6, 1 pl.). Description of the structure and life-cycle of a new haplocyte gregarine, *Enterocystis bullis*, sp.n., found in the intestine of a geophyrean, *Urechis caupo*, on the Californian coast. From a critical examination of a paper by Greef (1880) it is concluded that this author described two distinct gregarines under the name *Chonorhynchus gibbosus*. Noble proposes to separate one of them under the name *E. greefi* sp.n. (*nom. n.* for *C. gibbosus pro parte*). C. A. H.

Life-history of a New Gregarine.—E. R. NOBLE ("The Life-cycle of *Zygosoma globosum* sp. nov., a Gregarine Parasite of *Urechis caupo*," *Univ. California Publ. Zool.*, **43** (2), 1938, 41–66, 4 pls., 3 text-figs.). Description of the life-history of a new nonseptate gregarine, *Zygosoma globosum* sp.n., from the intestine of the geophyrean worm, *Urechis caupo*, along the coast of California. Particular attention is devoted to the chromosome cycle of the parasite in various stages of its development. A descriptive list is given of other species of *Zygosoma* recorded up to the present. C. A. H.

Coccidia of a Mole.—M. TANABE ("On Three Species of Coccidia of the Mole, *Mogera wogura coreana* Thomas, with Special Reference to the Life History of *Cyclospora caryolytica*," *Keijo J. Med.*, **9**, 1938, 21–52, 7 pls., 5 text-figs.). The author describes three species of coccidia found in the intestine of a Japanese mole, *Mogera wogura coreana*: *Cyclospora caryolytica*, *Eimeria scapani*, a new—but unnamed—species of *Eimeria*, and a form resembling *Adelina*. The morphology and life-cycle of these parasites are dealt with in detail. C. A. H.

Avian Haemocytozoa.—C. M. HERMAN ("The Relative Incidence of Blood Protozoa in Some Birds from Cape Cod," *Trans. Amer. Micr. Soc.*, **57**, (2) 1938, 132–41). The author examined blood films from over two thousand birds belonging

to 61 species, which were caught—and afterwards released—in connection with migration studies. Records are given of the incidence of various Hæmosporidia belonging to the genera *Plasmodium*, *Hæmoproteus*, *Leucocytozoon*, and *Toxoplasma*. The total number of infected birds was 209.

C. A. H.

Contractile Vacuole of *Paramæcium*.—J. A. FRISCH ("The Rate of Pulsation and the Function of the Contractile Vacuole in *Paramecium multimicronucleatum*," *Arch. Protistenk*, **90**, 1937, 123–61, 3 figs.). The rate of pulsation of the contractile vacuoles was estimated for *Paramæcium multimicronucleatum* and *P. caudatum*. In both it was found to be higher in the posterior vacuole than in the anterior one. This rate depends upon the condition and age of the culture and feeding, and also upon the locomotion of the ciliate. The activities of the contractile vacuoles and the radial canals are correlated with the activities of the cytostome and cesophagus in creating a stream of water through the animal, which serves for the intake of oxygen and for the elimination of products of metabolism and CO₂, besides regulating the water content of the cytoplasm. The contractile vacuoles thus have respiratory and excretory functions.

C. A. H.

Sexuality in *Paramæcium*.—(1) T. M. SONNEBORN ("Sex, Sex Inheritance, and Sex Determination in *Paramecium aurelia*," *Proc. Nat. Acad. Sci.*, **23**, 1937, 378–85).—(2) R. F. KIMBALL ("The Inheritance of Sex at Endomixis in *Paramecium aurelia*," *ibid.*, 469–74).—(3) —H. S. JENNINGS ("Sex Reaction Types and their Interrelations in *Paramecium bursaria*. I," *ibid.*, **24**, 1938, 112–7).—(4) H. S. JENNINGS ("Sex Reaction Types and their Interrelations in *Paramecium bursaria*. II. Clones collected from Natural Habitats," *ibid.*, 117–20). (1) The author discovered a sexually differentiated race of *Paramæcium aurelia* in which every individual is of one of two sexes, I or II, the vegetative progeny of any individual being of the same sex as the progenitor. When cultures of different sex are mixed the ciliates unite for conjugation, but when cultures of the same sex are mixed no conjugation occurs. After conjugation the four sets of progeny consist of the two sexes in chance combinations, the ratio being like that in higher organisms. It is held that sex determination depends upon the macronucleus.

(2) Working with the foregoing sexually differentiated race of *P. aurelia*, the author studied the inheritance of sex at endomixis. It was found that sex does not as a rule segregate at a later fission than the first after the formation of the anlagen. The distribution of sexes is random.

(3) The author confirmed Sonneborn's discovery, in *P. aurelia*, of sexually differentiated races for *P. bursaria*. The conjugation of heterosexual cultures was demonstrated by decolorizing the members of one sex (by depriving them of green algæ) and mixing them with a culture of green ciliates. In the resulting conjugation each couple consisted of one colourless and one green individual. Clones produced from exconjugants differ in many ways besides the differences in their sex types, e.g. in size, form, vigour, and sexual reaction.

(4) Twenty-seven clones of *P. bursaria* were isolated from various localities and tested with regard to sexual type, the sex being established by comparison with the two types already available. The various clones revealed nine diverse sex reaction types in this ciliate, which fall into two independent groups, the members of which do not conjugate with each other.

C. A. H.

Endomixis in *Paramæcium*.—(1) T. M. SONNEBORN ("The Delayed Occurrence and Total Omission of Endomixis in Selected Lines of *Paramecium aurelia*," *Biol. Bull.*, **74**, 1938, 76–82).—(2) B. F. PIERSON ("The Relation of Mortality after Endomixis to the prior Interendomictic Interval in *Paramecium aurelia*,"

ibid., 74, 1938, 235-43).—(3) J. GEBBER ("The Effect of Shorter than Normal Interendomitotic Intervals on Mortality after Endomixis in *Paramecium aurelia*," *ibid.*, 74, 244-6). This series of studies, all from the same laboratory, deals with the relation of endomixis to various vital activities in the ciliate, *Paramecium aurelia*.

(1) If daily isolation lines of *P. aurelia* are discarded as soon as endomixis occurs, and if these are replaced by sister lines before endomixis, it is possible to maintain for long periods lines which have not been in endomixis since the start of this procedure. At the end of these periods all the lines died.

(2) In lines of *P. aurelia*, in which the inter-endomitotic interval exceeds the standard interval of 20-30 days, there was a progressive increase of mortality after endomixis until 100 p.c. mortality occurred. At still higher intervals the ciliates died before endomixis could be induced. Long endomitotic intervals are regarded as the cause of "natural death" in ciliates.

(3) In lines of *P. aurelia* with abnormally short interendomitotic periods (18 and 10 days) the mortality is lower than in those with standard intervals. These and the preceding investigations [*vide supra* : (2)] have demonstrated that throughout the entire range of intervals the mortality after endomixis is directly proportional to the extent of the preceding interendomitotic period. C. A. H.

New Genus of Peritrichous Ciliates.—J. F. MUELLER ("A New Species of *Trichodina* (Ciliata) from the Urinary Tract of the Muskalonge, with a repartition of the Genus," *J. Parasitol.*, 24, 1938, 251-7, 1 pl. 1 text-fig.). Description of a new peritrichous ciliate near *Trichodina* from the urinary tract of an American pike ("muskalonge"), *Esox masquinongy*. This ciliate is referred to a new genus, *Vauchomia* gen.n., under the name *V. nephritica*, which is type-species. *Trichodina renicola* is likewise transferred to the new genus (= *V. renicola*). C. A. H.

Cyst-formation in a Peritrichous Ciliate.—L. E. ROSENBERG ("Cyst Stages of *Opisthonecta henneyi*," *Trans. Amer. Micr. Soc.*, 57 (2), 1938, 147-52, 1 pl., 1 text-fig.). An account of the factors inducing encystation and excystation in the peritrichous ciliate *Opisthonecta henneyi*, with a description of the morphological changes and processes taking place in the course of its life-cycle in culture. C. A. H.

Viruses.

The Formation of Herpetic Inclusions.—S. NICOLAU and L. KORCIOWSKA ("La morphologie de l'inframicrobe herpétique dans le tissu des animaux infectés expérimentalement et le mécanisme de la formation des inclusions qu'il engendre dans les cellules," *Ann. Institut Pasteur*, 1938, 60, 401-31, 10 text-figs.). The authors believe that the intranuclear inclusions formed by the herpetic virus in the neurones and the glial cells are composed of true colonies of herpetic virus. The herpetic virus can also be demonstrated in the cytoplasm of the neurones and glial cells and in the protoplasm of the endothelial cells of the capillaries and mononuclear cells of the meningeal infiltration. Similar virus colonies are produced by the zoster virus in human skin. After injection in peripheral nerves virus elements are found between the nerve fibres, in the interior of the fibres round the axis cylinders, and in the axis cylinders themselves. The intranuclear and cytoplasmic inclusions are regarded as due to the agglutination of colonies of virus particles, degeneration, fusion, and melting together (fonte) of a certain number of the virus particles. G. M. F.

The Specificity of the Guarnieri Body.—A. SQUARCIA ("Ulteriori indagini sul problema della specificità dei corpuscoli di Guarnieri," *Boll. Istituto Sieroterap.*

Milanese, 1938, 17, 29-46). Diphtheria and tetanus toxins produce certain changes in the corneal cells of rabbits which have been compared to the Guarnieri bodies produced by vaccinia. Numerous differences are, however, noted and the structures produced by the toxins are thought to be due to a form of nuclear degeneration. G. M. F.

A Virus isolated from the Cerebrospinal Fluid of a Case of Post-vaccinal meningo-encephalitis.—J. CAMINOPETROS, D. COMNINOS, and Mlle. DERVOU ("Etude expérimentale d'un virus isolé du liquide céphalo-rachidien d'un cas de meningo-encephalite post-vaccinale," *C.R. Acad. Sc.*, 1938, 207, 310-12). From the cerebrospinal fluid of a case of post-vaccinal encephalitis a virus was isolated which inoculated intracerebrally into rabbits produced fever after an incubation of 7-12 days. The animals usually recovered. The rat, mouse, and spermophile were also susceptible. Blood was particularly virulent. No meningeal lesions were noted. G. M. F.

Histopathological Alterations in the Nervous System of Rabbits Experimentally infected with the Virus of Equine Encephalomyelitis.—J. JABOTINSKI ("Les altérations histopathologiques du système nerveux des lapins dans l'infection expérimentale avec le virus de l'encéphalo-myélite équine," *Ann. Inst. Pasteur*, 1938, 60, 451-64, 7 text-figs.). The lesions produced by Russian strains of the virus of equine encephalomyelitis are described. In the horse icterus and parenchymatous changes in the liver are noticeable. In the rabbit after intracerebral inoculation the disease is of rapid onset. In the nerve cells Nissl granules rapidly disappear. The nuclei swell up and contain numerous basophilic granules of irregular shape and size; acidophilic granules are not seen. The attack on the nerve cells is accompanied by an insignificant reaction on the part of the mesenchymatous tissues. The action of the virus thus differs from that of the virus of Borna disease and of the American form of equine encephalomyelitis. G. M. F.

The Cytology of the Epithelial Cells and their Bearing on the Ætiology of Trachoma.—GRÜTER ("Die Mikrostruktur der Epithelzelle und ihre Bedeutung für die Aetiologie des Trachoms," *Rev. internat. du Trachome*, 1938, 15, 9-14). In the epithelial cells in trachoma the secretory granules swell and divide both in the cytoplasm and in the Golgi apparatus: sometimes forming a "hood-shape." Mitochondria also swell up and divide. The hood-shaped bodies are regarded as the Prowazek's bodies. The small granular bodies are regarded as non-specific. G. M. F.

The Matrix of the Trachoma Body.—P. THYGESON ("The Matrix of the Epithelial Cell Inclusion Body of Trachoma," *Amer. J. Path.*, 1938, 14, 455-62, 1 pl.). Observations corroborate Rice's finding that the inclusion body of trachoma contains a matrix composed of glycogen. The matrix is either absent or in low concentration in young inclusions and uniformly present in mature inclusions. Its formation is associated with the change from the large initial body form of the virus to the small elementary body form. The occurrence in the trachoma inclusion of a stainable matrix, characteristic of viruses, but unknown to Rickettsia is of interest. G. M. F.

Rotifera.

New Indian Rotifera.—J. HAUER ("Neue Rotatorienarten aus Indien," *Zool. Anz.*, 1936, 116, 77-80, 3 text-figs.; 1937, 119, 284-8, 2 text-figs.; 1937,

120, 17-19, 1 text-fig.). The material yielding the new species was collected in the Madras Presidency. *Monostyla bulla* Gosse forma *diabolica* is distinguished from the typical species principally by the possession of two short, curved spines directed forward and outward, arising from the dorsal plate at about one-quarter of its length from the anterior margin. In some specimens the spines differed in their length and in others one spine was reduced to a small boss. *Monostyla conspicua* has the ventral plate egg-shaped and the dorsal broad oval: the outline of both plates almost coincides over a large part of the sides. The anterior margins are also nearly identical, the dorsal having a smooth curve and the ventral being sinuous; laterally they end in acute, inturned points. The toe is parallel-sided and clawed. *Lecane sola* somewhat resembles *L. rhytida* Harring & Myers, but is smaller though relatively broader and the toes are much shorter. The anterior margins are straight and coincident; at the external angles they are produced into acute cusps. The surface markings on both dorsal and ventral plates are, of course, peculiar to this new species. *Trichocerca flagellata* has a broad, ovoid body with a high keel: the head is not distinctly demarcated and there are no anterior spines. The left toe is unusually long, being one and a half times the length of the lorica: it is slightly sigmoid in form. *Trichocerca tropis* is singular in having a highly developed keel which does not project straight from the body, but is curved over towards the right side. The foot is ventral and the two toes of equal length. The species somewhat resembles *Diurella voluta* Murray, but is larger, less hyaline, and differs in the trophi. *Brachionus angularis* Gosse var. *aculeatus* is characterized by the possession of a pair of stout, divergent spines at the posterior end of the dorsal plate and bearing, near their bases, subsidiary spines directed inward. The whole of the lorica is stippled. In the forma *lateralis* the outer angles of the lorica to the rear of the lateral antennæ project into short spines. A. E. H.

Drilophaga bucephalus Vejdovský.—L. K. PAWLOWSKI ("Drilophaga bucephalus Vejdovsky, ein parasitisches Radertier," *Mem. Acad. Polon. Sci.*, 1934, 6, 95-104, 3 text-figs.). This interesting Rotifer, ectoparasitic upon the Oligochaete *Lumbriculus variegatus*, has, since it was discovered in 1882, been so seldom refound that a satisfactory description of its anatomy has not been possible. The difficulty has been overcome by the finding of a large number of specimens in the Perty Sec, near Suwalki, Poland. The figures comprise a lateral view of the animal with the ciliary apparatus retracted, a dorsal view of the head parts, and the trophi. A table is given of differences between this and the other two species in the genus. A. E. H.

Diurella vernalis n. sp.—J. HAUER ("Zur Rotatorienfauna Deutschlands (VI)," *Zool. Anz.*, 1936, 115, Heft 11/12, 334-6, 1 fig.). This new species was found in the Eichener See near Schopfheim (Baden). It resembles *D. brachyura* Gosse, but is larger and there are distinct differences in the left manubria. A. E. H.

Sand Rotifera.—J. WISZNIEWSKI ("Notatki o Psammonie, IV-V. Notes sur le Psammon, IV-V., *Arch d'Hydrobiol., et d'Ichty.*, 1936, 235-43, 3 figs.). From a sand-bank in the river Vistula, near Czerniaków, twenty-eight species of Rotifera were obtained of which only two have not previously been found in the psammon. Despite the differences in their size the rivers Vistula, Oka, Bug, and Czarna show remarkable resemblances in the faunas. The examination of material collected from a number of mountain lakes in the Tatras region resulted in the identification of twenty-four species of Rotifera. The conditions are not favourable to the development of psammic species. A. E. H.

Sand Rotifera.—J. WISZNIEWSKI ("Zróznicowanie ekologiczne słodkowodnych wrotków psammonowych. Différenciation écologique des Rotifères dans le psammon d'eaux douces," *Ann. Mus. Zool. Polon.*, 1937, **13**, 1–13, 1 text-table.). The total number of known species viz. eighty-two, of Rotifera found in sandy environments is classified by the author according as they are peculiar to such associations or otherwise and also in relation to their abundance or rarity. Their distribution into groups with regard to the reaction and oxidability of the water is discussed.
A. E. H.

Deep-water Rotifera of Lake Michigan.—E. H. AHLSTROM ("The Deep-water Plankton of Lake Michigan, exclusive of the Crustacea," *Trans. Amer. Micr. Soc.*, 1936, **55**, 286–99, 1 plate). A total of 115 samples was collected by vertical haulage mostly from depths varying from 50 to 150 metres. The samples were examined for Algae (including Diatoms), Protozoa, and Rotifera. Of the latter, sixteen species were most in evidence, while twelve species, including nine not previously recorded for the Lake, were of only solitary or rare occurrence. Four species, of which two had not before been noted, were found in inshore tows. The majority are truly limnetic forms. There is evidently a seasonal periodicity in rotifera in Lake Michigan, but it is not as marked as in shallower, warmer bodies of water.
A. E. H.

Rotifera resembling *Cephalodella catellina*.—J. WISZNIEWSKI ("W sprawie Nomenklatury Grupy Gatunków Wrotków Zbliżonych do *Cephalodella catellina*," *Zool. Polonia*, 1936, **1**, **2**, 172–9, 1 fig.). The author submits that some confusion has existed in the literature relating to Rotifera which rather closely resemble *Cephalodella catellina* Muller, the type species of the genus *Cephalodella*. He treats *Diglena catellina* major and minor Zawadowsky, *Diglena catellina parasitica* Zawa., *Diglena volvocicola* Zawa., *Cephalodella volvocicola* Remane, *Cephalodella wiszniewski* and var. *volvocicola* Edmondson and Hutchinson, as identical with the type, and gives numerous references to papers all of which he considers relate to this same species. He further identifies *Cephalodella elmenteita* de Beauchamp with *Cephalodella fluviatilis* Zawadowsky and *C. catellina ahlstromi* Edmondson and Hutchinson with *C. myersi* Wiszniewski.
A. E. H.

BOTANY.

(Under the Direction of J. RAMSBOTTOM, O.B.E., Dr.Sc.)

Histology.

Structure of Australian Galls.—E. KÜSTER ("On the Histological Structure of Some Australian Galls," *Proc. Linn. Soc. N.S. Wales*, 1937, **42**, 57-64, 14 figs.). This paper is chiefly concerned with certain Coccid galls of *Eucalyptus*, which, in Australia, to some extent parallel the Cypnid galls of *Quercus* in Europe. The epidermis is remarkable for the occasional periclinal divisions and also for the rarity of any outgrowths or hairs. The vascular bundles are often numerous and highly differentiated. Coccid galls are very rich in stone cells, which, as in Cypnid galls, may be thickened on one wall only. The most noticeable feature of the Eucalypt galls is their richness in oil-receptacles. Voluminous masses of secondary tissue form from the normal cambial ring in many galls. W. R. P.

Embryogeny of *Datura Tatula* L.—I. M. GLIŠIĆ ("Macrosporogenesis and Development of the Macrogametophyte of *Datura Tatula* L.," *Bull. Inst. Jard. Bot. Univ. Beograd*, 1937, **4**, 1-23, 27 figs.). The ovary in *Datura Tatula* L. consists of two or three carpels, the primary loculus of each of which is divided into two by a secondary septum. Numerous anatropous macrosporangia are present in each loculus. The single-celled archesporium is often accompanied by a multicellular achesporial tissue. A linear row of tetraspores is formed by two successive meiotic divisions. The additional macrosporocytes do not develop. The innermost macrospore develops into the mature macrogametophyte, the other three degenerating. A typical 8-nucleate or 7-celled macrogametophyte is formed. A number of interesting exceptional cases were observed. These are the occurrence of more than one archesporial cell; variation in the tetraspore which matures; omission of tetrad formation; the occurrence of bi-nuclear cells in the nucellus below the archesporium; the development of two macrogametophytes in the same macrosporangium; and the development of a membrane dividing the 4-nucleate gametophyte into two 2-celled portions. W. P. R.

Development of Bud-Scales of *Viburnum*.—G. L. CROSS ("A Comparative Histogenetic Study of the Bud-Scales and Foliage Leaves of *Viburnum opulus*," *Amer. J. Bot.*, 1938, **25**, 246-58, 47 figs.). The morphology and anatomy of the foliar bud of *Viburnum Opulus* L. are described and particular features of the histogenesis of the cataphylls, transitional forms, foliage leaves, stipular appendages, and petiolar glands are described and compared. From these data it is evident that young cataphylls and foliage leaves diverge histogenetically at a very early stage, and staining reactions show that morphological divergence is preceded by an even earlier physiological differentiation. No evidence of a metamorphosis could be detected in the development of the cataphylls. Evidence of the homology of the cataphyll to any part of the foliage-leaf was not obtained, but rather the whole primordia are equivalent, any ultimate similarity being due to parallelism. Evidence is put forward that the stipular appendages are not stalked glands, but are vestigial lobes of the leaf. W. R. P.

Floral Anatomy of Apocynaceæ.—R. E. WOODSON and J. A. MOORE ("The Vascular Anatomy and Comparative Morphology of Apocynaceous Flowers," *Bull. Torrey Bot. Club*, 1938, **65**, 135–65, 5 pl., 72 figs.). This paper is the result of careful work on the structure of sixty-one species of forty-one genera of the Apocynaceæ. The stele of the pedicel is similar to that of young vegetative stems. It is amphiphloic and the internal phloem shows a tendency to diverge erratically into the pith. The calyx-traces arise in four distinct ways: (1) the calyx mid-ribs leave the stele and from the sides of each gap the laterals arise; (2) the laterals fuse with the corolline traces; (3) a single mid-rib leaves the stele and from it the laterals arise; (4) this type is a combination of either type (1) or type (2) with type (3). The correlation between the form of the calycine squamellæ and the petiolar glands (stipules) points to the former being of stipular origin. The anatomy of these squamellæ supports this interpretation. The vascular anatomy of the corolla and stamens is very simple. Five traces leave the stele opposite the five petals and from these any lateral traces in the petals subsequently arise. Almost at the same level five staminal traces arise which are unbranched throughout their length. The vascular anatomy of the corolline scales, arising as branches from the lateral corolla-traces, is parallel to the supply of stipules, whether simple or interpetiolar. The anatomy of the gynoecium shows clearly that the occasional unilocular ovary with parietal placentas has arisen by a splitting in half of two axile placentas, and that the explanation of a commissural stigma is unnecessary. The vascular supply of a series of gynoeciums and their nectaries is figured, and a number are described in detail. It is concluded that the nectaries represent sterile carpels.

W. R. P.

Seedling Anatomy of Cucurbita maxima.—A. G. WHITING ("Development and Anatomy of Primary Structures in the Seedling of *Cucurbita maxima*," *Bot. Gaz.*, 1938, **99**, 497–528, 6 figs.). The root-tip possesses a single histogen from which all the primary root tissues arise. The primary root is exarch, tetrarch. Differentiation of the large central metaxylem vessels is retarded. There is no pith. The primordium of a secondary root is formed from the cortex, including the endodermis, as well as the pericycle of the primary root. The transition extends from approximately 1 cm. below the peg to just above it. At the lowest level pith differentiates in the centre and the metaxylem takes up a peripheral position just within the phloem. Each xylem strand divides twice, forming a total of eight bundles which become endarch. Of these, usually two pairs anastomose, then divide into three, producing a total of ten bundles which continue through the hypocotyl. Additional bundles may arise. The bundle is considered bicollateral on the basis of ontogeny. A suggestion is made concerning the differentiation of two types of phloem, the one called fascicular phloem, the other connective phloem. A cotyledonary plate of four parts is produced by tangential anastomoses. Continuations from these form two traces to each cotyledon.

B. J. R.

Anomalous Thickening in Bauhinia japonica.—T. HANDA ("Anomalous Secondary Growth in *Bauhinia japonica* Maxim.," *Jap. J. Bot.*, 1937, **9**, 37–53, 1 pl., 10 figs.). Three different types of anomalous secondary growth are distinguishable in *Bauhinia japonica*. In the first type the centre of the stem is split up by the dilatation of the pith as well as of a certain part of the wood. In the parenchyma thus formed there arise several vascular bundles which develop a cambium. This type of growth occurs in certain parts of the stem not far above the base. In the second type the axial and peri-axial woods become separated by

the development of dilatation-parenchyma between them. Subsequently small vascular bundles become differentiated in the dilatation-parenchyma where they are arranged generally in two rows around the axial wood. The cambium of the inner row, in the usual manner, produces xylem on the inside and phloem on the outside, while that of the outer row produces the two components in the inverse orientation. This anomalous growth is shown for a certain length immediately above the stem base. The third type of anomalous growth is shown in the roots, especially the tuber-like ones. At first, active cell division occurs both in the pith and in the innermost region of the xylem, and thus the central area of the root becomes occupied exclusively by the dilatation-parenchyma. Then in this tissue many vascular bundles are differentiated, the arrangement and behaviour of which are the same as those described for the anomalous growth of the second type.

B. J. R.

Wood Structure of Australian Rutaceæ.—II. E. DADSWELL and A. M. ECKERSLEY ("The Wood Structure of Some Australian Rutaceæ with Methods for their Identification," *Council for Sci. and Ind. Res., Bull.* 114, Melbourne, 1938, 1-32, 10 pls.). The results of the examination of the wood structure of twenty-three species of Australian Rutaceæ are described. Particular attention is paid to the genus *Flindersia* on account of its economic importance. A description of each species covers the habit and distribution of the tree, the general properties of the timber, the wood anatomy, and a few notes on uses. These descriptions are illustrated by photomicrographs of the wood structure. There is a key to the identification of the timbers.

B. J. R.

Wood Structure of American Euphorbiaceæ.—S. J. RECORD ("The American Woods of the family Euphorbiaceæ," *Trop. Woods*, 1938, 54, 7-40). The family includes about sixty-five arborescent genera in Latin America, but most of the trees are small, often scarcely more than shrubs. The woods exhibit great diversity in appearance, properties, and structure. The outstanding features of most woods of the family are as follows: pores in multiples with tendency to radial rows; vessels with simple perforations and alternate pitting; rays fine and inconspicuous, often uniseriate; wood parenchyma reticulate or in concentric lines or bands, but rarely visible without a lens; wood fibres often very long, rarely septate, those with thick walls gelatinous, the pits minute, usually with small borders; large radial channels present in several genera, as in certain Apocynaceæ; crystals often abundant in either rays or wood parenchyma, occasionally in both; ripple marks absent. The general properties and wood structure of the American genera are described and there is a key to their identification.

B. J. R.

CRYPTOGAMIA.

Pteridophyta.

Isoëtes.—R. MELVILLE ("Isoëtes *Hystrix* at the Lizard," *Journ. of Bot.*, 1938, 76, 17-19). An account of the finding of *Isoëtes Hystrix* on the Lizard peninsula, the exact type of habitat in which it occurs, the plants with which it is associated, and the characters of the species itself, which show it to be perennial. It occurs over quite a large area wherever suitable conditions are found.

A. G.

Cyclosorus.—HIROSI ITO ("Filices Japonenses. VI," *Bot. Mag. Tokyo*, 1937, 51, 709-14, 725-30, 9 figs.). A revision of the Japanese species of *Cyclosorus*, nine in number, with their synonymy and distribution, a key to the species, and figures of the spores.

A. G.

Bryophyta.

Cyathodium.—APPASAHEB R. CHAVAN ("A Morphological Study of *Cyathodium Barodae*," *Amer. J. of Bot.*, 1937, **24**, 484–92, 78 figs.). A morphological account of a new species of *Cyathodium* from India. The plant is monoicous, and contains air chambers with stomata on the dorsal surface. The antheridial receptacle arises from a single cell and varies in position. The antheridia are separated by persistent septa, and are borne each on a stalk of two or three cells; their development is normal for the genus. Archegonial receptacles arise on the upper surface near the margin of the thallus and produce up to seven archegonia. The involucre is bilabiate. The embryo sporophyte shows in its development both the filamentous and octant types. The capsule has the structure characteristic of the genus; the seta is composed of one row of cells and the foot of four radiating lobed cells. The elaters are trispiral, nine to nineteen in number, and vary from 284μ to 760μ in length. The haploid number of chromosomes is three apparently. A. G.

Scapania.—W. E. NICHOLSON ("A New *Scapania* from Ireland," *Journ. of Bot.*, 1938, **76**, 15–17, 1 fig.). Description of *Scapania apiculata* Spruce var. *Jonesii*, a new variety collected by D. A. Jones and F. E. Milsom at Cromaglouin in August, 1935. It grows on the living bark of *Arbutus Unedo* in company with other hepatics. The peculiarities of structure are figured and discussed, and reasons given for regarding the plant as a variant of the more xerophytic *S. apiculata*. A. G.

Himalayan Mosses.—H. N. DIXON and R. L. BADHWAR ("Some New North-West Himalayan Mosses," *Records Bot. Survey India*, 1938, **12**, 163–79.) Descriptions of sixteen new species and two varieties of mosses from N.W. Himalaya, with topographical notes on the valleys in which they were collected. A. G.

Japanese Liverworts.—YOSHIWO HORIKAWA ("Two New Species of Thaloid Hepaticæ from Japan," *Bot. Mag. Tokyo*, 1937, **51**, 427–30, 3 figs.). Descriptions and figures of *Plagiochasma nipponicum* and *Riccardia pellioides* from Honshiu. A. G.

Japanese Mosses.—KYUICHI SAKURAI ("Beobachtungen über japanische Moosflora. XV," *Bot. Mag. Tokyo*, 1937, **51**, 791–97, 6 figs.). Descriptions of new Japanese mosses—eight species, three varieties, and one form—and notes on seven other species which are new records for the Japanese flora. A. G.

Thallophyta.**Algae.**

Eunotia.—KARL MÖLDER ("Die rezente Eunotien-flora Finnlands," *Ann. Bot. Soc. Zool.-Bot. Fennicæ Vanamo*, 1937, **8**, No. 7, 8–32, 3 pls.). A list of thirty-nine species and twenty-four varieties of *Eunotia* with synonymy, distribution in Finland, descriptive notes where necessary, and a number of figures. Several of these diatoms are of a cold-water type. Appended is a group of six descriptions of new species and varieties of diatoms belonging to the genera *Neidium*, *Pinnularia*, *Cymbella*. A. G.

Fragilaria.—JOHS. BOYE PETERSEN ("Fragilaria intermedia—*Synedra Vaucheriae*?" *Bot. Notiser*, 1938, 164–70, 1 fig.). A discussion of the difficulty caused by the close resemblance of *Fragilaria intermedia* and *Synedra Vaucheriae*, the only difference being that the first of these diatoms forms long chains. After a

careful study of original material of the two plants he comes to the conclusion that they belong to one and the same species, must be placed in *Fragilaria* because of the chain formation, and, bearing the oldest specific name, must be called *Fragilaria Vaucheriae*, a new combination. A. G.

Dutch Diatoms.—A. VAN DER WERFF ("De Diatomeeën van de IJsselmeer-kusten (1932 en 1933)," *Nederl. Kruidk. Archief*, 1937, **47**, 228–63, 18 figs.). An account of the diatoms of the shores of the IJsselmeer, collected in 1932, and comprising 120 species and twenty-four varieties with short descriptions and some figures. Previously only the plankton diatoms had been studied. A. G.

New and Rare Diatoms.—FR. MEISTER ("Seltene und neue Kieselalgen. II," *Ber. Schweiz. Bot. Ges.*, 1937, **47**, 258–76, 13 pls.). Descriptions and figures of new and rare diatoms from various sources—fifty-one from Japan, thirteen from Russia, seven from South America, and one each from Java, France, Switzerland. New to science are fifty-one species and ten varieties. A. G.

South African Diatoms.—S. ERLANDSSON ("Fresh-Water Diatoms from South Africa," *Bot. Notiser*, 1938, 170–82, 1 pl.). A list of sixty-four species and several varieties of diatoms discovered in four samples of silt collected by I. Örten-dahl in Cape Colony and S.W. Africa. A description is given of the new species *Surirella Oertendahlii*. A. G.

Philippine Diatoms.—B. W. SKVORTZOW ("Diatoms from the Philippines. I. Diatoms from Drinking Water, Balara, Rizal Province," *Philippine J. of Sci.*, 1937, **64**, 287–98, 2 pls.). A list of thirty-seven species and five varieties of diatoms obtained from a filter, all figured and briefly described. Four species, two varieties, and one form are described as new to science. Almost all the forms are of fresh-water nature and cosmopolitan in distribution. A. G.

Oscillatoria.—FRANCIS DROUET ("Three American Oscillatoriaceæ," *Rhodora*, 1937, **39**, 277–80, 3 figs.). Descriptions and figures of *Oscillatoria luteola* (n.sp.), *O. granulata* Gardn., and *Spirulina stagnicola* (n.sp.), with distribution and critical notes. A. G.

Chlorella.—HENRIK PRINTZ ("*Chlorella Nordstedtii* n.sp., a New Submarine Alga," *Bot. Notiser*, 1938, 77–82, 1 fig.). An account of the structure, spore formation, and affinities of a new species of *Chlorella*, which was found on and within the surface of old wood on the beach of Trondheimsfiord, and which flourished when cultivated in brackish water. The cells are 8μ to 10μ in diameter and contain a stellate chromatophore; the reproduction is by autospores 8 to 16 in each mother-cell. A. G.

Heterokontæ.—WILHELM VISCHER ("Über einige Heterokonten (*Heterococcus*, *Chlorellidium*) und ihren Polymorphismus," *Ber. Schweiz. Bot. Ges.*, 1937, **47**, 225–50, 14 figs.). Five species of *Heterococcus* were cultivated and studied; their development and variations of growth are described and figured; three of them are proposed as new species. A new genus of Heterococcales is described and figured, to wit, *Chlorellidium*, with one species, *C. tetrabotrys*; its main character is that the wall of the mother-cell neither becomes mucilaginous nor is cast off, but closely envelops the four autospores formed and holds them together as they grow. In discussing the possibility of affinity between simple filamentous Heterotrichales provided with a double wall and similar unicellular Heterococcales, and also the possible affinity of *Heterococcus* with *Pleurochloris*, *Ilsteria*, and *Chlorellidium*, the conclusion is reached that the Heterotrichales are apparently of polyphyletic origin. A. G.

Javan Phytoplankton.—G. HUBER-PESTALOZZI ("Phytoplankton aus Seen und Sümpfen Javas, gesammelt von Prof. C. Schröter," *Ber. Schweiz. Bot. Ges.*, 1936, **46**, 131–68, 13 figs.). A report on phytoplankton collected during May and June, 1927, in standing water of various kinds in Java, in ponds, brackish swamps, sawahs [flooded rice-fields], crater lakes, etc., at altitudes ranging up to 6,500 feet. The collection comprised thirteen genera of Cyanophyceæ, thirty-one of Chlorophyceæ, and a few each of Chrysomonadeæ, Euglenineæ, Peridinieæ, Heterocontæ; with a total of 180 species and varieties. The novelties are three species, five varieties, and a few forms. In the crater lake of Keloet was found a new species of *Surirella*, which is figured in an appendix. A. G.

Manchoukuo Algæ.—B. V. SKVORTZOV ("Notes on Algal Flora of Manchoukuo," *Bot. Mag. Tokyo*, 1937, **51**, 627–35, 677–88, 738–42, 783–91, 10 figs.). A series of notes recording the author's observations of the algal flora of Manchoukuo during the past few years. (1) Midsummer phytoplankton of a marshy river branch in the Sungari Plain near Harbin, with short descriptions and figures of eight species of Flagellatæ, eleven Protococcales, four Desmidiaceæ, forty Diatomaceæ, and thirteen Cyanophyceæ, including two new species of diatoms and three of Cyanophyceæ. (2) List of algæ from a single growth of *Spirogyra*, collected in the environs of Harbin. On the mucilaginous filaments of *Spirogyra decimina* were found two Conjugatæ, two Chlorophyceæ, two Cyanophyceæ, and twenty-one species of Diatomaceæ. Short descriptions and figures of these are given; and four new species are included. Half the algæ described are additions to the flora of Manchoukuo. A. G.

Swedish Algæ.—GÖSTA R. CEDERGREN ("Ein kurzer Beitrag zur Algenflora Medelpads," *Bot. Notiser*, 1938, 91–112, 1 fig.). A list of fresh-water algæ collected in the province of Medelpad, a district but little explored hitherto by algologists. The list comprises nearly 250 species, varieties and forms, and nearly 75 p.c. of these are Desmidiaceæ. The generic name *Stauroceras* of Kützing is revived for two species of *Closterium*. *Cosmarium marginatum* and *Staurostrum succicum* are described as new; and a section of *Cosmarium* is grouped under the new sub-generic name *Ephipiella*. A. G.

Dutch Algæ.—K. J. HOCKE HOOGENBOOM ("Wierenbegroeiing van de IJsselmeerkusten 1932 tot (Juni) 1935," *Nederl. Kruidk. Archief*, 1937, **47**, 280–334, 10 figs.). An account of the changes in the algal vegetation of the shores of the IJsselmeer from after May, 1932 (when the waters of the then Zuiderzee were cut off from the open sea), until the middle of 1935. The cessation of the rise and fall of the tide and the gradual conversion of the enclosed body of water from sea-water to fresh have resulted in the disappearance of half of the fifty higher algæ recorded by Van Goor in 1922 for the former Zuiderzee. On the other hand, several species of Cyanophyceæ are now found in the IJsselmeer which were not recorded by Van Goor. A. G.

Indian Zygnemoideæ.—C. BHASHYAKARLA RAO ("The Zygnemoideæ of the United Provinces, India. I," *J. Indian Bot. Soc.*, 1937, **16**, 269–88, 7 figs.). A list of Zygnemoid algæ mostly collected in the neighbourhood of Benares during the past two years, and all being first records for the local flora. The list comprises five species of *Zygnema*, twenty of *Spirogyra*, three of *Mougeotia*, two of *Sirogonium*; of these, three species, six varieties, and twenty-three forms are described as new, and figured. A. G.

Desmidiaceæ.—R. GRÖNBLAD ("Neue und seltene Desmidiaceen," *Bot. Notiser*, 1938, 49–66, 4 figs.). A list of thirty-two rare desmids with distribution, figures, and critical notes. Six species, eight varieties, and a form are new to science. A. G.

Ulvaceæ.—YUKIO YAMADA and EIJI SAITO ("On Some Culture Experiments with the Swarmers of Certain Species belonging to the Ulvaceæ," *Sci. Papers Inst. Algolog. Research Hokkaido Imp. Univ.*, 1938, 2, 35–51, 12 figs., 1 pl.). Some years of study of the reproduction of certain Ulvaceæ gave the following results: (1) In *Ulva pertusa* there are asexual plants and dioecious sexual plants; the gametes are isogamous; the zoospores are 4-ciliate; the germination of both zygote and zoospore are described. (2) In *Enteromorpha Linza* there are two kinds of swarmers found on different individuals, one kind (the commoner) having four cilia, the other two cilia; the germination is described. (3) In *Monostroma angicava* sexual plants only were found; these are dioecious; the male gametes are smaller than the female; the zygotes rest for eight months, then turn into zoosporangia and produce a large number of zoospores; the germination of these is described. (4) In *Monostroma pulchrum* only swarmers were found; these are four-ciliate; they come to rest and soon put out a germination tube, the apex of which thickens and grows gradually into a sporangium, from which after eight months a crowd of 4-ciliate swarmers are discharged. A. G.

Entocladia, Epicladia and Ectochæte.—HARALD KYLIN ("Über die Chlorophyceengattungen *Entocladia*, *Epicladia*, und *Ectochæte*," *Bot. Notiser*, 1938, 67–76, 4 figs.). (1) *Entocladia*, the name of which has been unjustly altered by some authors to *Endoderma* and *Entoderma*, was founded on an endophyte detected in the wall of *Derbesia*, a green alga, at Naples. The plant has also been recorded as occurring as an endophyte in brown and red algæ along the Atlantic coast of Europe, but such examples are probably not identical with the type species, *E. viridis*. Other species are found in *Zostera* and in old mussel shells, and *Tellania intricata* Batters, which lives in the periostracum of *Litorina obtusata*, is transferred to *Entocladia* by Kylin. (2) *Epicladia* occurs endozoically under the outer membrane of *Flustra* and *Sertularia*, and by reason of the parenchymatic disc of the older part of its thallus it is generically distinct from *Entocladia*. (3) *Ectochæte leptochæte* occurs as an endophyte in the wall of *Cladophora* and *Chaetomorpha*, and is essentially distinguished from *Entocladia* by forming hairs. Another species is *Ectochæte Wittrockii* (originally placed in *Entocladia* by Wille). The distinguishing characters of these two species are described and figured. The growth of *E. Wittrockii* in the walls of *Pylaiella littoralis* was studied in cultures and the life-history is described. A. G.

Enteromorpha.—CARL BLIDING ("Studien über Entwicklung und Systematik in der Gattung *Enteromorpha*. I," *Bot. Notiser*, 1938, 83–90). As a consequence of his researches the author claims that it is possible to draw sharp dividing-lines between species of *Enteromorpha* which are generally regarded as merging into one another. He lays down four characters for testing the plants: (1) the nature of the reproductive bodies (whether an alternation between gametes and zoospores, or whether neutral 4-ciliate swarm spores only); (2) experimental study of the copulation in case of plants with sexual reproduction; (3) cultivation of the zygote or of the asexual swarm spores up to maturity; (4) determination of the number of pyrenoids in vegetative cells (most of the species have but one pyrenoid). He gives an account of the reproduction and development of *E. minima*,

and shows that it is quite distinct in its swarm spores from both *E. intestinalis* and *E. compressa*, and must not be regarded as a variety of either of them. A. G.

Liagora.—YUKIO YAMADA ("The Species of *Liagora* from Japan," *Sci. Papers Inst. Algolog. Research Hokkaido Imp. Univ.*, 1938, 2, 1-34, 21 figs., 15 pls.). Descriptions and figures of fourteen species of *Liagora* collected on the Japanese coasts, eight of which are new to science. As a result of his long study of the genus the author finds that all the known species of *Liagora* can be grouped in four sections—Orientales, Validæ, Farinosæ, Mucosæ. And he supplies an analytical key to the Japanese species on these lines. The characteristics which must be taken into account in distinguishing the species are as follows: (1) shape of the assimilatory filaments; (2) position and shape of the spermatangia; (3) position, shape, size, and structure of the carpogonial branches; (4) structure of the carpogonial branches; (4) structure of the cystocarps. A. G.

Lomentaria rosea.—NILS SVEDELIUS ("The Apomeiotic Tetrad Division in *Lomentaria rosea* in comparison with the Normal Development in *Lomentaria clavellosa*. A New Type of Life-cycle among the Rhodophyceæ," *Symbolæ Bot. Upsalienses*, 1937, 2, Nr. 2, 1-54, 14 figs.). In *Lomentaria rosea* only tetrasporic individuals are known; its life-history and cytology are now made clear to us. The nuclear division of the tetrasporangium mother cell is not a reduction division. The chromosomes migrate into the nucleolus during the prophase, and are about twenty in number, and remain as twenty in the subsequent divisions and in the spores of the tetrad, and now the chromosomes migrate out of each nucleolus. The same chromosome number was also observed during mitosis in somatic cells. On several occasions it was observed that a whole tetrad would germinate, combining to form one germling; the occurrence of this *syngonic* development is discussed and interpreted as a proof of the apomeiotic formation of the tetraspores. In European waters none but tetrasporic individuals of *Lomentaria rosea* are known. For comparison with this species a cytological study of the normal diplobiontic *L. clavellosa* was made. Here a reduction division takes place at tetraspore formation; the male and female plants have ten chromosomes, and the tetrasporic individuals have twenty chromosomes. The development of the carpogonium is described in detail. By comparison *L. rosea* appears to be a reduced haplobiontic type. *Ahnfeltia plicata* is another reduced haplobiontic type in which fertilization is eliminated owing to degeneration of the female organs, and there is no tetrasporic generation. A. G.

Fresh-Water Phæophyceæ.—GUNNAR ISRAELSSON ("Über die Süßwasser-phæophyceen Schwedens," *Bot. Notiser*, 1938, 113-28, 2 figs.). An account of *Pleurocladia lacustris* and *Heribaudiella fluviatilis*, with their distribution in Sweden. They are fresh-water representatives of the Phæophyceæ, the one belonging to the Ectocarpales, the other a crustaceous alga formerly known as *Lithoderma fluviatilis*. A. G.

Germination in Fucus.—ERNST KÜSTER ("Normale und abnorme Keimungen bei *Fucus*," *Ber. Deutsch. Bot. Ges.*, 1937, 55, 598-605, 6 figs.). Descriptions and figures of deformed embryos obtained by cultivating the eggs of *Fucus serratus* on agar-plates. A. G.

Gametophytes of Laminariales.—TIYOITI KANDA ("On the Gametophytes of Some Japanese Species of Laminariales. II," *Sci. Papers Inst. Algolog. Research Hokkaido Imp. Univ.*, 1938, 2, 87-111, 24 figs., 2 pls.). An investigation of the

gametophyte generation of the following five Laminariales, viz. *Laminaria Yendoana*, *L. cichorioides*, *L. yezoensis*, *Kjellmaniella crassifolia*, *Chorda Filum*. In each case there is a description of the germination of the zoospores, the structure of the male and female gametophytes, the development of the young sporophyte. Only in the case of the zoospores of *Chorda* was an eye-spot observed. *Chorda* also differs from the other genera in certain other respects—partly in the gametes, principally in the young sporophyte. A. G.

Arthrothamnus.—YUKIO YAMADA ("Observations on *Arthrothamnus bifidus* J. Ag.," *Sci. Papers Inst. Algolog. Research Hokkaido Imp. Univ.*, 1938, 2, 113–18, 5 figs.). After a prolonged study of this alga the author shows how the sori of unilocular sporangia begin in parallel rows on the under-surface of the laminæ and gradually spread over the middle area of both surfaces; also how young laminæ are produced by fission from the peculiar convolute auricles at the base, a process which is illustrated with several figures. A. G.

Desmarestia.—KÔGORÔ ABE ("Entwicklung der Fortpflanzungsorgane und Keimungsgeschichte von *Desmarestia viridis* (Müll.) Lamour.," *Sci. Reports Tôhoku Imperial Univ.*, 1938, IV Ser., 12, 475–82, 6 figs., 1 pl.). An account of the reproductive organs and embryo-development in *Desmarestia viridis*. The sorus of unilocular sporangia is distinctly raised above the surface of the thallus. The two first nuclear divisions in the sporangium are reduction-divisions, and the number of chromosomes is found to be twenty-two. The swarmspores which escape from the sporangia mostly germinate asexually, but a proportion of them germinate after copulation. The sporelings are very like those of *D. aculeata*. In older cultures after two months are found the spear-shaped embryos of different appearance which arise erectly from the substratum and probably are the initial stage of the sporophyte generation. A. G.

Charophytes.—G. O. ALLEN ("Notes on British Charophytes," *Journ. of Bot.*, 1938, 76, 48–50). New records of charophytes in the British Isles, with some critical notes. A. G.

Nitella.—B. C. KUNDU ("A New Species of Polyarthrodactylous *Nitella* with a Review of the Allied Species," *J. Indian Bot. Soc.*, 1937, 16, 263–68, 1 pl.). Description of *N. Grovesii*, a new species from Shillong, Assam, and a key to all the polyarthrodactylous dioecious species of *Nitella*. A. G.

Japanese Algæ.—TAKASI HIROHASTI ("Preliminary Report on the Distribution of Marine Algæ of the Islands in the Northern Japan Sea," *Bot. Mag. Tokyo*, 1937, 51, 559–73, map and 3 figs.). A list of 157 marine algæ from three islands, Sadogasima, Awasima, and Tobisima, in the north sea of Japan, which are washed mainly by the warm water of the Tusima current and to a less extent by two colder currents. The study of the algal flora is thus of much interest, and had not been previously made. The list contains eighteen Chlorophyceæ, fifty-three Phæophyceæ, and eighty-six Rhodophyceæ. Seventy-five p.c. of the species belong to the warmer sea and 6 p.c. to colder waters, while 7 p.c. are cosmopolitan. Eighty-one species are endemic to Japan, thirty are Malayan, and eighteen are found also on the Pacific coast of America. The mild influence of the Tusima current extends but little to the coast north-east of these islands. A. G.

Japanese Algæ.—YUKIO YAMADA and TAKESI TANAKA ("The Marine Algæ from the Island of Yonakuni," *Sci. Papers Inst. Algolog. Research Hokkaido Imp. Univ.*, 1938, 2, 53–86, 13 figs.). A list of over one hundred marine algæ collected

for the first time on Yonakuni in the Ryukyu archipelago. Two new species belonging to *Derbesia* and *Spermothamnion* respectively are described and figured. A. G.

Japanese Algæ.—YUKIO YAMADA ("Notes on Some Japanese Algæ. VIII," *Sci. Papers Inst. Algolog. Research Hokkaido Imp. Univ.*, 1938, 2, 119–130, 4 figs., 13 pls.). A collection of fifteen marine algæ, eight of which are new to science and others are additions to the flora of Japan, illustrated and described or annotated. A. G.

Japanese Algæ.—SŌKITI SEGAWA ("On the Marine Algæ of Susaki, Prov. Izu, and its Vicinity. III," *Sci. Papers Inst. Algolog. Research Hokkaido Imp. Univ.*, 1938, 2, 131–53, 11 figs., 5 pls.). A collection of forty-six marine algæ from the Japanese province of Izu, comprising nine Chlorophyceæ, eight Phæophyceæ and twenty Rhodophyceæ. Among them are descriptions and figures of seven new species. A. G.

Fungi.

Chytrids.—F. K. SPARROW ("Some Chytridiaceous Fungi from North Africa and Borneo," *Tr. Br. Myc. Soc.*, 1938, 21, 145–52, 2 text-figs.). Three of the fungi from North Africa obtained in water culture from vegetable "trash" collected from a pond near Tangier are probably species of *Rhizophidium* and referable to European species. They are described shortly. The fourth from this locality was considered to differ so fundamentally from other known Chytrids that the new genus *Sporophlyctidium* was proposed for it. The Latin diagnosis for this was given in an earlier paper. The fungus is described and illustrated in detail. The Borneo material was preserved in formalin and consisted again of four Chytridiaceous fungi: (1) *Rhizophidium fusus* Zopf; (2) a fungus close to *R. carpophilum* or *R. minutum* Atk.; (3) a *Chytridium* resembling *C. Schenkii*, but differing in its small size and subapical germ-pore; and (4) a *Rhizophlyctis*, *R. borneensis*, on Diatoms. This species is new to science. F. L. S.

Operculate Chytrids.—J. S. KARLING ("Two New Operculate Chytrids," *Mycologia*, 1938, 30, 302–13, 37 text-figs.). Two new Chytridiaceous fungi are described. *Chytridium aggregatum*, saprophytic on dead and decaying threads of *Spirogyra crassa*, *Cladophora* sp., and *Edogonium* sp., is characterized by a persistent brown zoospore case, feeble motility of the swarmspores and gregarious habit. *Endochytrium digitatum*, saprophytic in *Chara* and *Nitella* internodes, is distinguished by the presence of one to several blunt digitations near the base of the sporangium or on the main axis of the rhizoidal system. Resting spores are smooth and light to medium brown. F. L. S.

Blastocystis.—R. CIFERRI and P. REDAELLI ("A New Hypothesis on the Nature of *Blastocystis*," *Mycopathologia*, 1938, 1, 3–7). The authors conclude from their study that *Blastocystis* is more closely related to the Protothecaceæ among the Oocystaceæ than to the yeasts or Chytridiales. F. L. S.

Blastocladia.—D. LLOYD ("A Record of Two Years' Continuous Observations on *Blastocladia Pringsheimii* Reinsch," *Tr. Br. Myc. Soc.*, 1938, 21, 152–67, 3 text-figs.). *Blastocladia Pringsheimii*, which was found in pools and a stream in the grounds of Holloway College, London, exhibited a variation in habit, but no periodicity. The development of the sporangium, with its simultaneous divisions

of the nuclei, was studied and described. No fusion was observed between the swarmspores, hence it is concluded, that they are zoospores and not potential gametes. F. L. S.

Sapromyces.—W. H. WESTON, Jr. ("Heterothallism in *Sapromyces Reinschii*. Preliminary Note," *Mycologia*, 1938, **30**, 245-54, 1 text-fig.). An account of P. H. Jordan's work on *Sapromyces Reinschii*. Attempts to grow pure cultures from single zoospores on artificial media failed, but basal cells, which originate from single zoospores, developed successfully. The heterothallic condition prevailed. A few aberrant cases were noted, e.g. one female, otherwise normal, developed oogonial initials without contact with a male. F. L. S.

Dicranophora.—C. G. DOBBS ("The Life-History and Morphology of *Dicranophora fulva* Schroet," *Tr. Br. Myc. Soc.*, 1938, **21**, 167-93, 2 pls.). *Dicranophora fulva* grew readily in culture, but produced no zygosporos on artificial media. Light tests showed that sporangia developed only when the fungus was illuminated, whereas zygosporos required darkness. Dimorphism of the spores, it is concluded, does not exist. The contents of a sporangium may be liberated as a single large spore. The sexual organs are described in detail. The female gametangium is peculiar in having an independent existence if sexual contact does not occur. F. L. S.

Hypocreales.—T. PETCH ("British Hypocreales," *Tr. Br. Myc. Soc.*, 1938, **21**, 243-306, 39 text-figs.). This is a monograph of the British Hypocreales. Two new species are described: *Calonectria tessellata*, on decaying stalks of *Brassica* and *Gliocladium strictum*, the conidial stage of *Hypomyces Broomeanus* on *Fomes annosus*. F. L. S.

Mycosphærella.—B. H. DAVIS ("The *Cercospora* Leaf-Spot of Rose caused by *Mycosphærella rosicola*," *Mycologia*, 1938, **30**, 282-99, 7 text-figs.). A perithecial stage of *Cercospora rosicola* Pass. was found on over-wintered rose leaves. Genetical connection was proved culturally. The combination *Mycosphærella rosicola* (Pass.) Davis is proposed. Beside this study a comparative analysis of the *Cercosporæ* described for rose in the literature showed that there are in reality but three species: *C. Rosæ* (Fuck.) v. Höhn, *C. rosicola* Pass., and *C. hyalina* Muller and Chupp. A fourth species was collected in the Southern United States, and this is described as new: *C. Puderii*. F. L. S.

Wheat Rust.—T. SĂVULESCU ("Biologische Studien über den Weizenbraunrost in Rumänien," *Grigore Antipa*, Jubilee no., Bucharest, 1938, 67 pp., 3 pls.). A detailed account of the macro- and microscopic characters as well as of the parasite and host relationships of the orange rust of wheat in Roumania. Temperature effects were studied and experimental infection of *Thalictrum* spp. by the basidiospores of *Puccinia triticea* was carried out. On *T. flavum* well-developed æcidia were formed. Various varieties resistant and otherwise were studied. Anatomical and osmotic conditions of the hosts were also investigated. F. L. S.

Fruit Rust.—J. C. DUNEGAN ("The Rust of Stone Fruits," *Phytopath.*, 1938, **28**, 411-27, 2 text-figs.). *Tranzschelia Pruni-spinosæ* (Pers.) Diet. is the cause of a disease on *Prunus* spp. and is of considerable economic importance throughout the world. It is generally confined to the leaves, but may attack the fruit of the peach. In attempting to investigate the variations in the prevalence and importance of the disease it was found that uredospores of cultivated forms would not infect wild species and *vice versa*. In the same way æcidiospores from wild species

of *Anemone* would infect leaves of wild species only of *Prunus*, and the same held for the cultivated species, which would only infect cultivated plants. Examination of herbarium specimens showed that there is a difference in the teleutospores from wild and cultivated hosts. As a result of the investigation the rust species is broken up into two varieties: *Tranzschelia Pruni-spinosæ typica* for the variety on wild species, and *T. Pruni-spinosæ discolor* for the fungus on cultivated plants. Descriptions are given of both varieties. F. L. S.

Urocystis.—B. B. MUNDKUR ("Urocystis sorosporioides, a New Record for India," *Tr. Br. Myc. Soc.*, 1938, **21**, 240-3, 1 pl.). A smut on the leaves and petals of a *Delphinium* collected at Simla is identified as *Urocystis sorosporioides* Kern. and described. F. L. S.

Ustilago.—D. ITZEROTT ("Über Keimung und Wachstum von *Ustilago Zeæ* (Beckm.) Ung. mit besonderer Berücksichtigung der Infektion," *Phytopath. Zeitschr.*, 1938, **11**, 153-81). The germination of the brand spores of *Ustilago Zeæ* were tested in solutions of varying concentration and acidity. Maximum germination occurred at pH 4.4. Increasing acidity reduced germination until at pH 2.5 it was zero. Slight acidity and slight alkalinity inhibits, to some extent, germination of spores over a year old. At pH 8.55 germination of such is completely inhibited. The production of sporidia and general development show the same dependence on pH relations. The effects of certain metals and temperature on germination and growth were also investigated. F. L. S.

Pleurotus.—G. MÉTROD ("Quatre petits Pleurotes blancs," *Revue de Mycologie*, 1938, **3**, 78-85, 4 text-figs.). *Pleurotellus septicus*, *P. candidissimus*, *Acanthocystis myzotrichus* Lév., and *Panellus mitis* (Fr. & Pers.) Kühner are described with details concerning macroscopic and microscopic characters and habitat. The figures illustrate spores, basidia, and cystidia. F. L. S.

Omphalia.—D. E. BLISS ("Two New Species of *Omphalia* which cause Decline Disease in Date-Palms," *Mycologia*, 1938, **30**, 313-27, 10 text-figs.). Two species of *Omphalia* were isolated from the roots of date-palms affected with decline disease. They are described as new to science. *Omphalia pigmentata* has a mycelium resembling glass wool and producing an orange to cadmium pigment. The spores are $6-9 \times 4-6.5\mu$. In *O. tralucida* the mycelium has a fine texture and pigment is absent. The spores are $11-16 \times 3-6\mu$. F. L. S.

Rhodophyllus.—H. ROMAGNESI and J. FAVRE ("Quelques Rhodophylles nouveaux ou rares des hauts marais jurassiens," *Rev. Mycologie*, 1938, **3**, 60-78 2 pls., 9 text-figs.). An account, illustrated by coloured drawings, of five species and one variety of *Rhodophyllus* new to science. F. L. S.

Resupinate Polypores.—D. V. BAXTER ("Some Resupinate Polypores from the Region of the Great Lakes. IX," *Mich. Acad. Sci. Art and Letters*, 1937, **23**, 285-305, 9 pls.). Twelve *Porias* from North America are described in detail; among them four are new to science. In addition, the characteristics of ten resupinate polypores in culture are discussed. F. L. S.

Ceratostomella.—J. C. WENT ("Compilation of the Investigations on the Susceptibility of Different Elms to *Ceratostomella Ulmi* Buisman in the Netherlands," *Phytopath. Zeitschr.*, 1938, **11**, 181-202). Different elms were inoculated experimentally by means of a syringe with *Ceratostomella Ulmi*. The Asiatic species, *Ulmus pumila* and *U. pumila pinnato ramosa*, were very resistant, but as

they are susceptible to attack by *Nectria*, they cannot be planted in Holland. Others, resistant and useful for parks, are *U. parvi folia*, *U. Shirasawana*, and *U. Sieboldii*. A large number of elms were found to be less susceptible than the Dutch elm but unsuitable for planting. The American and most of the European elm species are very susceptible. Certain more or less resistant specimens were, however, found among the seedlings of European elms—the most resistant of these is “Christine Buisman,” a Spanish seedling of *Ulmus foliacea*. F. L. S.

Actinomyces.—P. NEGRONI (“Estudio micológico del *Actinomyces discofoliatus* Grüter, 1932, señalado por primera vez en La Argentina,” *Mycopathologia*, 1938, 1, 81–8, 3 pls.). *Actinomyces discofoliatus*, which causes lachrymal concretions and human actinomycosis, was studied microscopically and physiologically. Details of macroscopic and microscopic aspects are given of cultures grown on numerous media. Photographs and drawings of cultures and of spores and hyphae illustrate the text. F. L. S.

Actinomycoses.—A. and R. SARTORY (“Les Actinomycoses rénales,” *Mycopathologia*, 1938, 1, 7–10). A study of renal Actinomycoses indicated that little work has been done on the subject, perhaps due to its rarity and perhaps due to the difficulty of investigating it. Often, too, the disease has been confused with tuberculosis. Careful diagnosis is necessary. Actinomycosis can be cured by specific medical treatment, whereas for tuberculosis surgical methods are invariably necessary. F. L. S.

Actinomyces.—A. G. GIBSON, R. H. ROSE-INNES, and J. GIBSON (“A Human Infection with *Actinomyces Capræ*,” *Br. Med. J.*, 1938, 1, 612). A fungus identified as *Actinomyces Capræ* was obtained in cultures from the spleen which had been removed from a patient suffering from acholuric jaundice. The authors conclude that this organism was an essential pathogenic agent in the production of the disease. F. L. S.

Oidium.—R. CIFERRI, P. REDAELLI, and C. CAVALLERO (“*L'Oidium albicans* Robin,” *Mycopathologia*, 1938, 1, 115–6, 2 pls.). A monographic account and analysis of the morphological, biochemical, and taxonomic characters of the fungus indicated by the name *Oidium albicans*. Fifteen strains from different parts of the world were studied. F. L. S.

Mycotorula.—B. BESTA (“Il fenomeno della dissociazione in uno stipite di *Mycotorula albicans*,” *Mycopathologia*, 1938, 1, 41–53, 2 pls.). From a strain of *Mycotorula albicans* of the normal type a rough verrucose strain was obtained. From a physiological study and micro- and macroscopical characters it is concluded that the so-called dissociation of this species is related to polymorphism and polymetry of the cells. F. L. S.

Torulopsis.—J. LODDER and N. F. DE VRIES (“Some Notes on *Torulopsis glabrata* (Anderson) nov.comb.,” *Mycopathologia*, 1938, 1, 98–104). A yeast which had been isolated from three independent human lesions was studied and it was found that it must correspond to the fungus described by Anderson as *Cryptococcus glabratus*, but should be placed in the genus *Torulopsis*. The literature is surveyed, and the fungus described from its clinical, morphological, physiological, pathogenetic, and mycological aspects. F. L. S.

Penicillium.—Y. S. SABET (“Contributions to the Study of *Penicillium egyptiacum* van Beyma,” *Tr. Br. Myc. Soc.*, 1938, 21, 198–211, 1 pl.). The effect of

various external and cultural conditions on *Penicillium egyptiacum* is described. It produces perithecia readily in culture. Humidity was found to have most influence on perithecial formation, but special conditions are not necessary. The species is homothallic.

F. L. S.

Verticillium.—I. W. TERVET and J. M. ESSELMONT ("A Fungous Parasite of the Eggs of the Gray Field Slug," *J. Quekett Micro. Cl.*, 1938, ser. 4, 1, 1-4, 2 pls.). Many eggs of the field slug (*Agriolimax agrestis*) failed to hatch. On being kept moist for some weeks they became completely covered with *Verticillium chlamydosporium* Goddard. Tests and infection experiments indicated that although this was the most frequent parasite, it is not necessarily the only one to produce non-development of the eggs. The chlamydospores of the fungus differ slightly in size from those previously described for *V. chlamydosporium*, but the authors believe that there is no justification for regarding their fungus as other than a strain of this species.

F. L. S.

Trichophyton.—S. MILOCHEVITCH ("*Trichophyton immergens* et ses Manifestations Cliniques," *Mycopathologia*, 1938, 1, 88-98, 3 pls.). An account of the clinical and cultural aspects of a species of *Trichophyton* described for the first time and named *T. immergens*. It was found eleven times on man and once on cattle. It chiefly attacks the glabrous skin, but occasionally also the beard. The lesions are orbicular, with a tendency to spread and to produce suppuration. It is a typically megasporous *Trichophyton* and the manner in which it differs from similar *Trichophytons* is detailed.

F. L. S.

Trichophyton in Nature.—I. MUENDE and P. WEBB ("Ringworm Fungus growing as a Saprophyte under Natural Conditions," *Arch. Derm. & Syph.*, 1937, 36, 987-90, 2 text-figs.). *Trichophyton gypseum-asteroides* was found on the walls and excreta in two sheds which served seventeen calves on a farm near Oxford. The calves were heavily infected, but apparently had been quite healthy before they were confined to the sheds. The fungus was cultured and guinea-pigs inoculated. This is apparently the first record of a *Trichophyton* growing as a saprophyte under natural conditions.

F. L. S.

Moulds and Asthma.—E. M. FRAENKEL ("Moulds and Asthma," *Br. Med. J.*, 1938, 2, 68). Positive skin tests with moulds and bacteria were obtained comparatively frequently in England, and the percentages are about the same as for Seattle, Washington. On the other hand, the tests for Germany correspond with those from the interior of the United States and are less frequent. The differences are thought to be due to the moister climate of England and Seattle compared with Germany and Central America.

F. L. S.

Allergy.—C. R. OWEN, M. B. ANDERSON, and A. T. HENRICI ("Allergy in *Monilia* and Yeast Infections," *Mycopathologia*, 1938, 1, 10-26). After studying the literature and their own experimental work on the occurrence of allergic reactions to yeasts and monilias, the authors reach the following somewhat tentative conclusions: that spontaneous infection may be manifested by generalized eruptions; that sensitization is in some instances a prerequisite for infection; that unequivocal results from skin tests can be obtained only by inoculation of living cells; that dead cells, filtrates, and extracts give weak or non-specific reactions.

F. L. S.

Pea Disease.—L. L. HARTER ("A Root-Rot Disease of Peas caused by *Fusarium cæruleum*," *Phytopath.*, 1938, 28, 432-8). *Fusarium cæruleum*, not

previously recognized as a parasite of peas, was found to cause a root-rot of this plant and to be widely distributed in the United States. Twenty-four varieties of pea were inoculated, but none showed resistance to the disease. F. L. S.

Root-Infecting Fungi.—S. D. GARRETT ("Soil Conditions and the Root-Infecting Fungi," *Biol. Reviews*, 1938, **13**, 159–86). In reviewing the ecology of root-infecting fungi, Reinking's distinction between "soil inhabitants" and "soil invaders" is made. The former are considered to be primitive or unspecialized parasites with a wide host range. Their parasitism appears to be incidental to their saprophytic life as members of the general soil microflora. The soil invaders, to which the majority of soil-infecting fungi apparently belong, are more highly specialized parasites. Their presence in the soil is usually closely associated with that of their host plants. In the continued absence of the host such fungi will die out of the soil. The effect of soil conditions, such as moisture, texture, organic matter, and chemical composition, upon a number of soil-borne fungus diseases is discussed. F. L. S.

Norfolk Fungi.—G. J. COOKE ("Norfolk County List of Fungi," *Tr. Norfolk and Norwich Nat. Soc.*, 1937, **14**, 292–300, 1 pl.). The paper deals with the Gasteromycetes of Norfolk. Forty-eight species are recorded with notes on locality, date of finding, and frequency. It is hoped to publish a list of Agarics, the remaining Basidiomycetes, and Ascomycetes in subsequent papers. F. L. S.

Rio Grand Agarics.—J. RICK ("Agarici Riograndenses," *Lilloa*, 1938, **2**, 251–316). In this diagnostic list of macrofungi from the Rio Grand, the following genera have had new species attributed to them: *Clitocybe* three, *Collybia* six, *Mycena* six, *Omphalia* four, *Russula* two, *Hygrophorus* three, *Zentinus* three, and *Phyllotremella* one. One new genus *Lepiotella* is described. It is characterized by a discrete volva, persistent ring and remote lamellæ, and is apparently based on and synonymous with *Amanitopsis lepiotiodes* Barla. F. L. S.

Roumanian Fungi.—T. SĂVULESCU ("Contribution à la connaissances des macromycetes de Roumanie," *Acad. Romana mem. Sect. Stiintifice*, 1938, **13**, 72 pp.). A review of the literature of the larger fungi of Roumania is followed by a general account of them. The study has resulted in an addition of sixty-four species and five genera to the macromycete flora of the country, bringing the total to 568 species belonging to 127 genera and nineteen families. Tables are made of the fungi indicating what authors recorded them. In the special part of the paper 196 species are dealt with, either in detail or with annotations. F. L. S.

Swedish Fungi.—J. A. NANNFELDT ("Contributions to the Mycoflora of Sweden," *Svensk Bot. Tidsk.*, 1938, **32**, 108–20, 1 text-fig.). In a previous paper the delimitation of the tribe Acetabuleæ and the genera *Helvella* L. & Fr. emend. Quèl. and *Pustularia* Fuckel emend. Boud. (non Rehm) was discussed. The chief difference was found to be that the spores of *Helvella* are uni-guttulate when mature, with four nuclei, while in *Pustularia* the spores are biguttulate with one equatorial nucleus. In the present paper *Pustularia* is further discussed and after excluding some doubtful members, *P. catinoides* Fuckel and *Peziza puteræformis* Dur. & Lév. it is found to be a very uniform group. A diagnosis is given. *Peziza radiculata* is examined and a new genus is created for it—*Sowerbyella*, to which *Aleuria unicolor* Gill. is also brought. F. L. S.

Uruguay Geasters.—K. CEJP ("Some Remarks on the Genus *Geaster* Mich. from Uruguay," *Lilloa*, 1938, 2, 17–23, 1 pl.). *Geaster asper* (Mich.) Lloyd, *S. mammosus* Fr., and *S. umbilicatus* Fr. from Uruguay are recorded and described in detail. F. L. S.

Lichens.

Systematy and Phylogeny of the Genus *Cladonia*.—F. MATTICK ("Systembildung und Phylogenie der Gattung *Cladonia*," *Beih. Bot. Centralbl.*, 1938, 58, Abt. B, 215–34). After a historical review of the development of a classificatory system of the genus *Cladonia* from the time of Linnæus to the present day, the author proceeds to deal with the probable phylogeny. Five main groups are distinguished, based on the degree of development of the podetia. The original forms from which the genus *Cladonia* arose were apparently crustaceous lichens with sessile, pale apothecia, similar to *Lecidea* sect. *Biatora*. Differentiation as to the colour of the apothecia (pale, red or brown) must have occurred simultaneously with the commencement of podetial development, and the separation of forms with gaping axillæ (*Pervia*) from those with completely closed podetia (*Clausæ*) occurred also at an early evolutionary stage. There is strong evidence to show that *Cladina*, with its evanescent crustaceous thallus and strongly developed podetia, is the most highly evolved group within the genus. Of the two main groups, *Clausæ* and *Pervia*, the former contains the subdivisions *Coccifera*, *Ochroleuca*, *Foliose*, *Podostelides*, and *Thallostelides*, the latter the subdivisions *Chasmaria*, *Unciales*, and *Cladina*. The subgenus *Cenomyce*, considered by Wainio to be sufficiently characterized by the squamulose primary thallus, is considered to be too indefinite in its delimitation to be retained. The paper closes with an enumeration of the European species arranged according to the foregoing classification. I. M. L.

***Cladonia Grayi* Merr. in Belgium.**—P. DUVIGNEAUD ("Notes sur des lichens de Belgique. II. Le *Cladonia Grayi* Merr.," *Bull. Soc. Roy. Bot. Belg.*, 1937, 70, 39–40). *Cladonia Grayi* Merr. differs from *C. chlorophæa* Flk. only in the absence of Fumar-protocetraric acid, and can be distinguished from the latter by the mild taste and absence of any reaction with Paraphenylenediamine. It has already been recorded from N. America and Germany, and is now recorded from Belgium (three localities). A revision of copious herbarium material of "*C. chlorophæa*" and "*C. pyxidata*" showed that it is rare in that country. I. M. L.

Saxon Physciaceæ.—A. SCHADE ("Die sächsischen Arten der Flechtenfamilie der Physciaceæ sowie die Verbreitung von *Physcia cæsiella* (B. de Lesd.) Suza in Mitteleuropa. Die Flechten Sachsens III.," *Beih. Bot. Centralbl.*, 1938, 58, Abt. B, 55–99, 1 fig.). An enumeration, with exact localizations and critical notes, of the species of *Anaptychia* and *Physcia* occurring in Saxony. One species of the former and fourteen of the latter are now known with certainty from this region. The author considers *Physcia ascendens* Bitter to be a good species, distinct from *P. tenella*, and not, as had been suggested by B. de Lesdain, a pathological modification due to the ravages of mites. *P. cæsiella* (B. de Lesd.) Suza is recorded from Germany for the first time; it is now known to occur elsewhere in Czechoslovakia, Galicia, Ukraine, Hungary, Roumania, Tirol, Switzerland, France, Belgium, and Sweden. Further search should be made for this species, which differs from *P. cæsia* in the marginal lip-like soralia. The

specific distinctness of *P. orbicularis* and *P. sciastra* is called into question. A key to the species known to occur or probably to be found in Saxony is given.

I. M. L.

Belgian Lichens.—P. DUVIGNEAUD ("Lichens récoltés lors de l'herborisation de la Société royale de Botanique de Belgique, les 19 et 20 juin 1937, dans la région jurassique," *Bull. Soc. Roy. Bot. Belg.*, 1938, **70**, 162–8, 1 fig.). An enumeration of lichens collected in the Jurassic region of Marbehan and Virton, arranged according to associations. *Parmelia cetrarioides* Del., *Pertusaria hemisphaerica* (Flk.) Erichs., and *Physcia caesiella* (B. de Lesd.) Suza are new to the Belgian flora. The colonization of calcareous outcrops by lichens was also studied.

I. M. L.

Some Exotic Ramalinæ.—Ö. SZATALA ("Ramalinæ Nonnullæ," *Fedde, Repertorium*, 1937, **42**, 225–8). A revision of the species of *Ramalina* present in the Budapest Botanical Museum from the following regions: Java, Madagascar, Comores, N. Zealand, Azores, N. Africa, N. and S. America. One species, *R. Zollingeri* Sztat., from Java, is new to science.

I. M. L.

Brasilian Lichens.—G. MALME ("Lichenes Nonnullæ in Expeditione Regnelliana Prima Collecti," *Ark. f. Bot.*, 1937, **29A**, no. 6, 1–35). In this posthumous publication various smaller groups of the lichens collected by the first Regnell Expedition in Brasil are dealt with. The genera enumerated are: *Verrucaria* (four new species, one new variety), *Staurothele* (two new species), *Endocarpon* (one new species), *Clathroporina* (one new species), *Phyllobathelium*, *Calicium*, *Tylophoron*, *Chiodecton* (three new species), *Mazosia*, *Byssoloma*, *Diploschistes*, *Crocynia*, *Cænogonium*, *Peccania* (one new species), *Catillaria* (two new species), *Toninia* (three new species), *Lopadium* (five new species, one new variety), *Hæmatomma* (one new variety), *Ochrolechia* (one new variety, one new form), and *Candelaria*. Keys are supplied to the Brazilian representatives of *Verrucaria* and *Lopadium*.

I. M. L.

The Geography of Palestine Lichens.—I. REICHERT ("Eine Licheno-geographische Skizze Palästinas," *Verh. Zool.-Bot. Ges. Wien*, 1937, **86/87**, 288–96). The various climatic regions of Palestine have been found to be characterized by certain species of lichens, which can therefore be used in the same way as phanerogams as indicators of the regions in question. Their distribution is important for purposes of plant-geographical study, particularly in the Saharo-Sindic deserts, where very few phanerogamic plants are present which may be used as indicators in the above sense.

I. M. L.

New or Rare Lichens.—M. SERVÍT ("Seltenere und Neue Flechten," *Mém. Soc. Roy. Lettres et Sci. Bohême*, 1937 (1936), no. xii, 1–16). Critical notes on a number of lichens from France, Germany, Czechoslovakia, Dalmatia, Greece, Russia, and Algeria. New to science are *Verrucaria Schindleri* Serv., *Polyblastia Nádvorníkii* Serv., *Gyalecta Fritzei* var. *Kul'ákii* Serv., *Gonohymenia myriospora* var. *depauperata* Serv., *Parmelia Mougeotii* ff. *deminuta* and *incurvoides* Serv., *Caloplaca cæsiorufa* var. *Hilitzeri* Serv., *C. calcicola* var. *Rechingeri* Serv., *C. Rechingeri* Serv., *Buellia Flageyana* Serv., and *B. Steineri* Serv.

I. M. L.

Hymenolichenes.—F. TOBLER ("Über den Bau der Hymenolichenen und eine neue zu ihnen gehörende Gattung," *Flora*, 1937, **131**, 438–47, 7 figs.). In the Hymenolichenes the fungal component is the element which conditions the form of the lichen-thallus as a whole. The lichen formerly known as *Chiodecton san-*

guineum, having been proved to belong to the Hymenolichenes, is now made the type of a new genus, *Herpothallon* Tobler. Here the union between fungus and alga is comparatively loose, the latter being introduced superficially. Although no spores or basidia have yet been found, the presence of clamp-connections proves that the inclusion of the new genus among the Hymenolichenes is correct.

I. M. L.

The Gonidia of Some Marine Arthopyreniæ.—J. FELDMANN ("Sur les gonidies de quelques Arthopyrenia marins," *Rev. Bryol. et Lichénol.*, 1937, 10, 64-73). The pyrenocarp genus *Arthopyrenia* was separated from *Verrucaria* on account of its Trentepohlioid (not Protococcoid) gonidia. However, four marine species formerly regarded as belonging to *Arthopyrenia* (*A. foveolata* A.L.Sm., *A. litoralis* (Tayl.) Arn., *A. halodytes* (Nyl.) Arn., and *A. leptotera* (Nyl.) Arn.) have been found to possess Cyanophyceous gonidia. The three former species have been considered by Keissler to have gonidia of the *Pleurococcus*-type, and on that account were introduced by him into the genera *Thelidium* and *Paraphysothele*, but the present author's investigations, partly on type-material, place their Cyanophyceous nature beyond doubt. "*Arthopyrenia litoralis*" and "*A. foveolata*" cannot at present be included in any of the three pyrenocarp families characterized by Cyanophyceous gonidia, because their algal components are *Mastigocoleus* and *Hyella*, whereas the *Pyrenidiaceæ*, *Pyrenotrichaceæ*, and *Xanthopyreniaceæ* have as gonidia *Nostoc*, *Scytonema*, and *Glæocapsa* respectively. A marine association between a fungus described as *Epicymatia Balani* Wint. and the Rivulariaceous *Brachytrichia Balani* is also regarded by the author as a lichen, for which yet another family of pyrenocarp lichens would have to be created. The author, however, abstains from this course, pointing out that in all these species the fungal components are very similar and may even be conspecific, perhaps capable of symbiosis with a variety of different *Cyanophyceæ*. This theory is borne out by the fact that both *Mastigocoleus testarum* and *Hyella cæspitosa* occur as gonidia in "*Arthopyrenia litoralis*." The view is held that a logical classification of lichens should be based on the fungal component only, and the group interpolated within the orders of fungi, as already attempted by Clements and Shear.

I. M. L.

BOOK REVIEWS.

Recent Advances in Cytology.—By C. D. DARLINGTON. 2nd Edition. 1937, xvi+671 pp., 160 figs., 16 plates. Published by J. & A. Churchill, Ltd., 104, Gloucester Place, Portman Square, W.1. Price £1 1s.

This book really deals with the nucleus rather than the cell. Numerous works on karyology have appeared in recent years—a natural result of the stimulus arising from the fact that the nucleus provides the basis for most of the modern conclusions in genetics. Cytological progress, both in technical methods and in results, has therefore been very rapid, and will doubtless continue so for some time to come.

Since the chromosomes constitute the basic hereditary material, their structure and division and their movements in mitosis are bound to receive increasingly analytical investigation, in terms of the ultimate constitution of proteins on the one hand and the physics and physical chemistry of colloidal aggregates on the other. But in addition to all this, the cytologist has to remember that the nucleus is a structure with a history almost as old as life itself—even if we disregard the numerous speculations linking virus particles with “genes.” Chromosome phylogeny as a basis for the phylogeny of genera and larger units is already a recognized branch of cytology and will make even more rapid advances in the next decade.

Dr. Darlington's book, first published in 1932, although written from a particular point of view and rather overloaded with hypotheses, has nevertheless shared in this advance and has doubtless done much to stimulate it in certain directions. The second edition has not only been completely revised, but is over 100 pages longer. The numerous tables, compiled with much labour, make the book very useful to all plant cytologists as a work of reference, whether they agree with the author's views or not. Our present knowledge of the origin and nature of nucleoli, representing, as it does, one of the most important recent advances in karyology, is still inadequately treated in the present edition. The last chapter, which was intended as a summary of evolutionary ideas has been revised out of existence in the new edition.

The leading idea of the book, on which a heavy super-structure of hypotheses is hung, remains unchanged, namely that chromosomes are single structures, dividing only in the resting nucleus, and that meiosis therefore differs from mitosis in showing a delay of the split from leptotene to the diplotene stage. Even when this book was first published, the weight of evidence was already considered by many to be against the assumption that the chromosome is a single structure. Now that it has been clearly proved to be double in anaphase and telophase, quadruple in metaphase, the whole tissue of hypotheses based on its supposed singleness collapses. Such incidents are not surprising in cytology, especially when hypothesis proceeds too far in advance of established fact. When they occur, the only course is to discard frankly the outworn hypotheses and make a fresh beginning on a sound basis.

Finally, reference may be made to a few matters of detail noticed as requiring correction for any future edition. In the list of tetraploids, the case described by Fikry (1930) in *Rumex scutatus* is omitted. The table (p. 221) of measurements of cell size in polyploids omits the classical case of *Oenothera gigas*, in which this matter was rather fully investigated in 1909. Certain inaccurate statements (pp. 10, 12) regarding the male gametophyte and the generative nucleus could be revised by reference to any good elementary text-book of botany. The assumption (p. 40) that the satellite thread is unspirialized is probably contrary to fact. Reference is made (p. 503) to R. S. Lillie's hypothesis (1903) on physiological grounds that chromosomes should bear an electrical charge and therefore repel each other at certain stages of mitosis; but no mention is made of the observations (1909) in which it was shown, by published figures and descriptions, that the chromosomes take up peripheral equidistant positions against the nuclear membrane in a way that can only be accounted for if they mutually repel each other. R. R. G.

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TRANSACTIONS OF THE SOCIETY.

XI.—SOME EXPERIMENTAL RULINGS BY THE LATE
MR. H. J. GRAYSON.

By L. C. MARTIN, D.I.C., A.R.C.S., D.Sc., Assistant-Professor in the
Technical Optics Section, Imperial College of Science and Technology.

(Read October 19th, 1938.)

ONE PLATE.

IN January, 1933, the present writer published a short note on the preparation of films of so-called realgar similar to those employed by the late Mr. H. J. Grayson for ruling the beautiful test-plates for which he became famous. This note elicited a paper (1934) from Mr. W. Stone of Melbourne, who had been closely associated with Grayson in much of his work ; the paper described the method more fully and confirmed that the preparation of the films by evaporation was substantially as described by myself ; it gave particulars of other methods tried in the earlier work. In 1935 Prof. Sir Thomas Lyle and Mr. Stone kindly sent me a number of specimens for examination in the hope that more details regarding the technique might appear as the result of close inspection.

The specimens merit more work than has been found possible, but if any member of the Royal Microscopical Society has occasion to take an interest in them, they will be held available for such further tests.

Grayson's early ruling engine (1937^{1,2}) was employed for making micro-meters and test-plates up to 40,000 lines to 1 in. The rulings were usually made on glass, and careful annealing had to be carried out. The shallower, finer lines produce but little optical contrast, especially if the grooves become

partly filled with water droplets, and a greater optical path difference can be obtained by depositing a layer of material of high refractive index (the so-called realgar) over the ruling so as to fill the grooves. The films prepared by myself appear to have been a mixture of sulphides of arsenic, with possibly free sulphur, but Grayson described his test-plates as "mounted in pure realgar; refractive index 2.549."

When the second machine was made, which ruled up to 120,000 lines per inch, it was found easier and more effective to rule the grooves on the smooth surface of the realgar itself. The film was distilled on to the under side of a cover-glass, and the latter cemented down to the slide after ruling. Stone (1934) mentions some of the defects which appeared in certain cases. Some particulars of the more interesting of the specimens now to hand are appended:

- (1) Test ruling; 1,000 to 10,000; internal cement used, but realgar film cracked and pieces displaced, showing lines to be on the film. Approximate thickness of realgar film (measured; see below) 1.7×10^{-2} mm.
- (2) Realgar film detached from cover-glass except at edges; film wavy and cracked; strongly birefringent crystals between film and cover-glass.
- (3) Cover-glass cracked; film has receded from edge of crack to form ridge and also from boundary of the original film patch, leaving isolated drops of realgar.
- (4) Micrometer slide; rulings apparently on cover glass and filled probably with graphite; small cavities or bubbles in the colourless mounting medium.
- (5) Realgar film deposited on slide; ring of transparent cement round edges; asphaltum (?) cement round cover-glass; no internal cement.
- (6) Realgar film on cover-glass; slide broken and layer of cement can be seen on realgar film. Cement closely resembles Canada balsam in general character.

The remaining slides show various singularities and differences, but the above specimens are fairly characteristic.

A quick method for testing a slide for the presence of an air film is to immerse it in a small beaker of water and allow light to traverse it obliquely. The air film will cause total reflection.

Another test is to employ an auxiliary microscope with tube horizontal to project a small image (of a brightly illuminated aperture) close to the plane of the slide which, held at 45° to the vertical, reflects the light upwards in to the observing microscope. By this means the successive images of the test object can be studied; their relative brightness and colour afford clues to their origin and to the refractive index changes at the various reflecting surfaces. In a case when an internal cement having a refractive index close to that of the glass is used, the only strong reflections will occur at the outer air surfaces of the slide and cover-glass and at the surfaces of the realgar

film. The most prominent reflections will therefore be two "plain" and two coloured images, since the light reflected at the two lowest surfaces will suffer a double transmission at the yellow-coloured film. Two standard Grayson test rulings, examined in this way, showed four such images and it is fairly clear that Grayson's standard method was to employ an internal cement.

In a letter to me, Mr. Stone described a method of examination very similar to the above arrangement.

The thickness of the realgar film in specimen 1 was found by measuring the apparent distance between the top and bottom edges of obliquely fractured pieces of the film with the aid of the graduated fine adjustment of the microscope. The slide was mounted on the stage in the normal way. Measurements could also be taken so that the bottom edge of the film was seen through the realgar, thus obtaining the apparent thickness as modified first by the cement and then by the refracting substance of the film itself.

Results were as follows :

Mean apparent thickness of realgar film	$= 1.1 \times 10^{-2}$ mm.
(Allow for a refractive index of cement = 1.52)	
Then, actual thickness of film	$= 1.66 \times 10^{-2}$ mm.
Apparent mean thickness of film, as seen through the realgar	$= 0.7 \times 10^{-2}$ mm.
Hence, estimated refractive index of film	$= 2.4$.

This value is fairly consistent with Grayson's stated refractive index, but the estimation of the apparent thickness in particular is subject to a large error, at least 10 p.c., and nothing more is to be inferred from the above figures than their consistency with the assumed constitution of the slide, with an internal cement of refractive index about 1.52.

One slide, not amongst those mentioned above, had been left unfinished. The mounting medium had been squeezed out from under the cover-glass and had hardened irregularly around it. The realgar had run into drops around the very edge of the circular patch of film, but had not otherwise separated from the glass, so that the mounting had been a successful one. I was fortunate enough to have the assistance of Dr. H. F. Harwood and Dr. A. Brammal of the Imperial College in examining a small quantity of the cement by micro-chemical methods. It was found that it was indistinguishable from Canada balsam as far as tests could be applied, although it is difficult to differentiate between this and other similar substances of vegetable origin. It was found not to contain any metallic elements such as lead, which would have suggested the use of gold-size.

Some months ago I had occasion to try to cement such realgar films down with Canada balsam ; but in all cases after a day or two the film showed a tendency to strip from the support and assume a wavy appearance like No. 2. I concluded at the time that either the cleaning of the glass before depositing

the film had been faulty or that some different cement should have been tried.

When experimenting with the production of such realgar films, I found that if insufficient sulphur was used in the distillation a fine structure might be produced, but nothing resembling the strongly birefringent crystals of specimen 2. The crystals appear to be formed on the realgar layer where it has separated from the cover-glass, for in certain cases the images of the lines on the film, displaced by refraction, can be seen through the crystal edges. This suggests that the crystals are formed in the mounting medium itself, although no case of the production of such forms in ordinary Canada balsam has ever come under my notice. This suggested that the mounting medium might be one containing metallic salts, but Dr. Harwood's tests do not confirm this. Perhaps some member of the Royal Microscopical Society may be able to suggest their origin.

In conclusion, it seems fairly clear that the main outline of Grayson's methods are now known, but many details remain to be discovered. It is very much to be hoped that some worker with the necessary time and resources will essay the reproduction of such test-plates and, if so, it will be well worth while to devote some renewed attention to the early trial efforts of the pioneer.

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- MARTIN, L. C. (1933) *J. Sci. Instr.* **10**, 187.
— (1937¹) *Ibid.*, **14**, 8.
— (1937²) *Ibid.*, **14**, 309.
STONE, W. (1934) *Ibid.*, **11**, 1.

APPENDIX.

During the discussion, Dr. E. E. Jelley said that he had found that Canada balsam thinned with xylol was capable of dissolving sulphur in considerable quantity. He suggested that the crystals in Grayson's slides might prove to consist of orthorhombic sulphur. It might be that sulphur had been dissolved from certain films (thus loosening them from the glass) and subsequently recrystallized, or Grayson might even have developed the plan of saturating the balsam with sulphur in order to avoid the stripping of the film. He offered to make an examination of the crystals by determining their birefringence.

Subsequently to the meeting Dr. Jelley wrote as follows: "I am returning under separate cover the slide you so kindly lent to me, together with one showing the effect of crystallizing sulphur from hot xylol balsam.

"Many of the crystals in your slide are undoubtedly orthorhombic sulphur, as was found by measuring the birefringence and optical thickness for the faster ray for crystals presenting a centered interference figure. Sodium

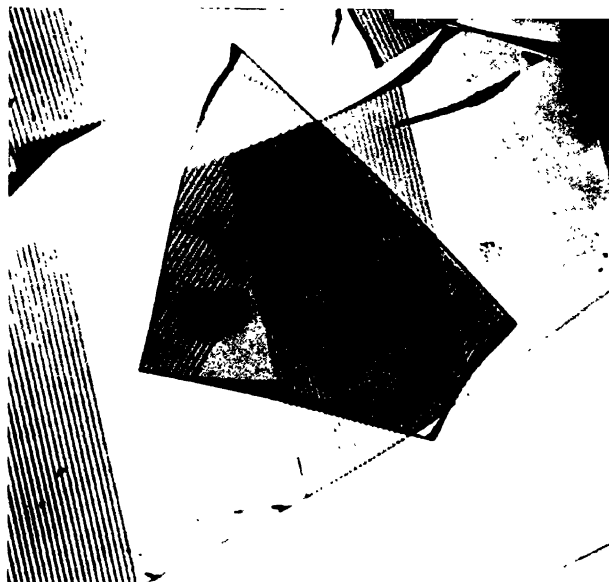


FIG. 1.

Showing rulings on 'realgar' film. $\times 300$, approx. The realgar film has cracked and separated from the support.



FIG. 2.

Crystals in mounting medium over realgar film. $\times 300$, approx.

light was used for determining the birefringence, which was measured with a Berek compensator. The following results were obtained:—

“Case 1.—Normal to surface of slide = acute bisectrix = Z;

Birefringence/optical thickness = $n_a(n_\beta - n_a) = b_z$.

Found, $b_z = 0.16, 0.16, 0.19, 0.17, 0.14$.

Theoretical for orthorhombic sulphur, $b_z = 0.159$.

“Case 2.—Normal to surface of slide = obtuse bisectrix = X.

Birefringence/optical thickness = $n_\beta(n_s - n_\beta) = b_x$.

Found, $b_x = 0.40, 0.43, 0.44, 0.42, 0.44$.

Theoretical for orthorhombic sulphur, $b_x = 0.423$.

“Case 3.—Normal to surface of slide = optic binormal = Y.

Birefringence/optical thickness = $n_a(n_s - n_a)_s = b_y$.

Found, $b_y = 0.57, 0.59, 0.52$.

Theoretical for orthorhombic sulphur, $b_y = 0.564$.

The chief source of error in these determinations was that in measuring optical thickness.

“The crystals in your slide are all positively bi-axial and some had an observed value of half the optic axial angle, measured in a medium of $n = 1.52$, of between 46° and 51° . Taking the value of n_β as 2.038 , this reduces to a value of $2V$ between 65° and 71° . The value for orthorhombic sulphur is 69° .

“A curious feature of many of the crystals in your slide is that an optic axis is very nearly normal to the surface of the slide, so that the birefringence is very low. If these crystals, also, are sulphur, it is possible that the presence of realgar may have caused them to grow in an unusual plane. I did not, however, find any crystals in your slide which, on the basis of optical measurements, were not orthorhombic sulphur.”

Note by L. C. M.

Dr. Jelley's interesting and valuable method of measuring birefringence per unit optical thickness (i.e. thickness divided by refractive index) was unknown to me, and I understand it has not been previously published.

His discovery of the nature of the crystals and his suggestions made during the discussion open up the lines on which the remaining details of the mounting technique can be investigated if and when required.

It only remains to return sincerest thanks to Dr. Jelley as well as to Dr. Harwood and Dr. Brammal for their valued assistance.

XII.—PHOTOMICROGRAPHY AND RECORD PHOTOGRAPHY WITH DUFAYCOLOR.

By S. R. WYCHERLEY, F.R.M.S.

(Read October 19th, 1938.)

BLACK-AND-WHITE photography has been an instrument of the utmost value to scientific workers in every field.

Colour photography, however, while a still more efficient instrument, has failed to occupy the position it should. This has been occasioned by various difficulties in the use of photographic material employed in the various colour processes.

To obtain a photograph in colour by any process it is necessary to record at least three impressions, the redness, greenness and blueness of the subject. The earlier methods of accomplishing this consisted of taking three separate negatives on separate supports and thereafter combining their positives, either by optical or other means, to form a colour picture.

In 1862 Louis Ducos du Hauron published a theory that the three colour records could be combined upon one support, with the advantage that all three exposures could be made at one and the same moment and the result observed as a finished picture without the necessity for special apparatus or the need to combine three separate records in register. This was accomplished by distributing the three records over the surface of the picture in the form of microscopic dots or elements of the three colours in close juxtaposition, but not superimposed in any way.

The processes of additive screen colour which have been or are available can be divided into two groups :

(a) Those having an irregular colour mosaic pattern, such as Lumière and Agfa.

(b) Those having a regular mosaic pattern, such as Finlay and Dufaycolor.

In group (a) the mosaic is obtained by the distribution of dyed resin or starch grains over the surface of the material. This distribution is made as even as possible, but owing to their nature the elements are inclined to clump in irregular groups and have to have the intervening spaces filled in by an opaque material. Hence the transparencies of such material are somewhat dense in character. The colour rendering, however, is of a high order of excellence.

In group (b) the mosaic is present in regular geometric form, and owing to the fact that no opaque material is introduced the overall transparency is of

a higher order. Further, pure dye colours are used, which are naturally more transparent than dyed resin or starch grains and the final transparencies thus gain in clarity and brilliance.

In Finlaycolor Process the ruling has to be of somewhat coarse nature, as in this process use is made of a black-and-white image, which is in registration with a colour-mosaic-viewing screen carried on a separate support. If the ruling were finer than it is at present it would be impossible to put both image and screen into correct registration by any form of manual operation.

In the Dufaycolor process the viewing and taking screen, the so-called *Reseau* (or colour mosaic) is an integral part of the sensitive material, hence it is possible to have a very much finer ruling as there is no need for any form of manual adjustment to secure registration. The fineness of ruling (40 lines to the millimetre) together with the high order of transparency of the dyes used combine to produce a medium which is peculiarly suited to the needs of the scientific worker. The fine screen pattern permits of the recording of very fine detail, which is of obvious value. The transparency of the film makes it suitable for lantern slides or for any other form of projection, and as the actual original photograph can be used for this purpose, lecturers and teachers will appreciate the fact that they are not involved in the extra cost of making lantern slides, though duplicates can be produced if required.

The material is obtained either in the form of cut film for loading into dark slides of the standard sizes or can be had in the form of roll film. All Dufaycolor is non-inflammable in character.

In manufacture the raw base is covered with minute areas of red, green, and blue dyes, arranged in a geometrical pattern, and upon this is coated the sensitive emulsion. The exposure is made through the base of the material, so that the incoming light is intercepted by the filter pattern before reaching the emulsion.

Dufaycolor film is usually developed as a reversal material, in that the first negative image is removed by subsequent chemical action, and the remaining part of the emulsion is given an exposure to light and developed to form the final positive image.

Assuming that the object which is being recorded is red in colour, each portion of the image that is focused on to the base will only pass through the red elements and be recorded by the emulsion immediately behind each red element. This exposure will first be developed to form a negative and, by chemical treatment, will subsequently be bleached away to leave a clear space behind each red element that goes to make up the image. The emulsion behind the blue and green elements also on being exposed to light and developed forms an opacity behind the green and blue elements only. Thus, on viewing the final transparency in white light, no light will be able to pass through the blue and green elements owing to the presence of silver behind them, while the red will be seen at its correct intensity.

The general technique employed in monochrome photomicrography applies to Dufaycolor with the following differences :

To secure accurate colour rendering a compensating filter must be used for the light source employed, e.g. white flame arc : low voltage, high amperage lamps, projection type lamps, Pointolite, etc.

The compensating filter must be placed somewhere in the optical system, preferably near the sub-stage. It is not advisable to place the filter in such a position that it will get unduly hot (e.g. mounted on the lamp house), nor should it be placed in such a position that only a small area of the filter is in actual use (i.e. at or near the focus of the condenser).

The compensating filters are of a special character devised by Dufay-Chromex Ltd. to ensure accurate colour rendering when various light sources are used and, when films are ordered, the light source to be used should be mentioned. Further, Dufay-Chromex Ltd. for accurate professional work adjust the filter not only to light sources but also to the material selected for this purpose, so that filters are supplied with each box of material carefully adjusted to give the best result. When ordering filters separately the batch number of the material should be mentioned.

In monochromatic photography when photographing differentially stained subjects it may sometimes happen that two widely different colours have the same photographic effect, in that they produce equal blackness on the film. To overcome this difficulty, either one of the colours must be suppressed or the other must be accentuated.

But when making a photomicrograph in Dufaycolor the contrast filters as used in monochrome photomicrography are quite unnecessary, as the material retains the actual colour difference.

The loading of Dufaycolor should preferably be done in total darkness, as the emulsion is extremely sensitive to all colours of the visible spectrum. It is possible to employ a deep green panchromatic safelight whose light is being reflected from the ceiling as an illuminant for the darkroom, providing the Dufaycolor stock is kept away from the direct reflected rays.

The films are packed six sheets in a box all facing the same direction, and each has hinged to it at one end a sheet of black paper exactly the same size, which covers and protects the emulsion-coated side.

Dufaycolor must be exposed through the base, i.e. the side not coated with emulsion, as has been previously explained and therefore special care must be taken in loading. The base side, which is smooth to the touch and not protected by the paper cover, must face the lens, the emulsion with its paper protection facing towards the back of the camera.

There are three methods of loading :

- (a) Film holders or sheaths.
- (b) Glass or cardboard behind the film.
- (c) Glass in front of the film. It is most important that the glass should be free from imperfection and foreign matter.

Exposure.—It is difficult, if not impossible, to give accurate information of correct exposure by means of exposure tables, as it will depend upon a number of diverse factors :

- (1) The type and strength of the light source employed.
- (2) The distance of the light source from the sub-stage condenser.
- (3) Whether or not a collecting lens is used.
- (4) The working aperture of the objective.
- (5) The magnification on the ground-glass screen.
- (6) The transparency of the specimen (depth of staining, etc.).
- (7) The form of illumination, viz. transmitted light, polarized light, or dark-ground illumination, etc.

It should be remembered that the exposure increases as the square of the magnification and varies inversely as the square of the working aperture. Once the exposure has been worked out (by the test strip method) for a given set of conditions, there remain only four variables :

- (a) Working aperture.
- (b) Magnification.
- (c) Nature of the specimen to be photographed, which can be gauged by experience.
- (d) Source of illumination.

As a very rough guide the following may be of use : 5-amp. arc, white flame 24 in. from sub-stage, 6 in. focus collecting lens, Abbé condenser, $\frac{1}{4}$ -in. objective, N.A. 0.8, W.A. approx. 0.5, $\times 8$ eyepiece, magnification $\times 200$, medium-stained specimen, Dufay compensating filter, exposure 1/10th second.

Instructions for processing are contained with every package of the material. The methods are simple and could be carried out by any junior laboratory assistant. The formulæ here follow arranged in their logical sequence.

1. *First Developer* (dish). Time $2\frac{1}{2}$ minutes ; 65° , 18° C.

Metol . . . . .	..	..	..	..	3 grams
Sodium sulphite (cryst.)	..	..	..	..	100 grams
Hydroquinone	..	..	..	..	6 grams
Potassium bromide	..	..	..	..	2.75 grams
Water to	..	..	..	..	1,000 c.c.
Aminonia, sp. g. 0.880	..	..	..	..	12 grams

2. *Rinse* 30 seconds.

3. *Reverser*. Time, 3 minutes.

N.B.—After $1\frac{1}{2}$ minutes the white light may be turned on.

Fresh solution should be used for each batch of transparencies which is placed in the bath.

Potassium permanganate	..	..	..	2 grams
Potassium persulphate	..	..	..	0.5 grams
Water to	..	..	..	1,000 c.c.
Conc. sulphuric acid	..	..	..	10 grams

N.B.—Add the acid very slowly, stirring the solution well.

Under no circumstances powder the potassium permanganate in a pestle and mortar, as it will become explosive in contact with organic matter.

4. *Rinse*, 30 seconds.

5. *Clearer*.

Potassium metabisulphite ..	..	..	..	25 grams
Water to ..	..	..	..	1,000 c.c.

6. *Rinse*, 2 minutes.

7. *Exposure* (fogging).—The film should have the surplus water shaken off and be exposed emulsion side towards the light of a 60-watt frosted lamp at a distance of 6 inches for about 1½ minutes.

8. *Second Developer*.—Develop in the first developer for 4 minutes; at 65° F., 18° C.

N.B.—The first developer can be used for three or four films as second developer, but never again as first developer.

9. *Rinse* 5 minutes.

10. *Hardening Bath*, 5 minutes.

Chrome alum ..	..	..	..	25 grams
Water to ..	..	..	..	1,000 c.c.

11. *Wash*, 15 minutes.

12. *Wipe off* surplus water carefully with either a viscous sponge or a good-quality chamois leather and place in a dust-proof place to dry.

Provided that exposure has been accurate the result of these operations will be a brilliant transparency.

The use of achromatic objectives and Abbé condensers may cause slight colour fringing around any sharply defined edge, such as hair or sharply defined cellular structure. The use of apochromatic objectives and condensers and compensating eye-pieces will eliminate such trouble.

The various stains used in botanical, histological and pathological specimens are very well recorded, and striking demonstration photographs can be obtained by the use of dark-ground illumination, particularly when illumination such as the use of Rheinberg filter discs is employed.

The value of photographs showing differential staining or illumination as outlined above is obvious. The petrological worker, and those who use polarized light generally find rock sections and chemical slides rendered brilliantly when photographed by Dufaycolor. The whole range of the visible spectrum is registered and thus the interference colours given by the mineral or chemical crystals under observation, which are mainly a function of their thickness and orientation, are photomicrographically recorded.

A most interesting series of photographs can be prepared from petrological sections showing the angles of extinction of various minerals, repeating the photographs of the same subjects at different angles of rotation of the microscope stage.

Interesting comparison pairs can also be made by photographing the same sections with the nicols crossed and parallel.

Dufaycolor will also record brilliantly rings and brushes shown by various minerals under the microscope using the Bertrand lens.

As an illustration, colour photographs of two sections of quartz, one thick and one thin, under crossed nicols, show rings of varying widths and colour fringes.

A double screen of mica can also be photographed showing the four eyes at the four 90 degree positions, and gives a very striking effect.

From the foregoing brief examples it is readily apparent that the ability to record photographically the colour effects that can be observed visually in the microscope places in the hands of the record and research worker a valuable process, and for this purpose Dufaycolor is a suitable medium and the simplest to use.

* In communicating the foregoing paper the author illustrated it with a large collection of colour lantern-slides.—Ed.

XIII.—ON A NEW DESIGN OF MICROMANIPULATOR

By W. W. HANSEN, Physics Department, Stanford University.

(Read November 16th, 1938.)

ONE PLATE.

As is well known, a micromanipulator is a device which can be used to move a quartz needle or other instrument through small distances in any direction. There must be a considerable ratio between the motion of the operator's hand and the resulting motion of the needle. Besides this absolute requirement the ideal micromanipulator would possess other desirable properties, such as good rigidity, freedom from backlash, ease of construction and freedom from wear. It is the object of the present note to describe a new design of micromanipulator which possesses these and other desirable features.

In designing an instrument like a micromanipulator, where great perfection of action is required, it will prove profitable to start from first principles.¹

Thus we first note that any rigid body has, if unconstrained, six degrees of freedom. That is, it can move in any of six essentially independent ways. For example, it can be translated in three mutually perpendicular directions (axes) and can be rotated about any of these axes. Now if the body be constrained so as always to touch a certain point it will have only five independent motions, if two points, only four, until if it be required to touch six points it will, in general, be held fast. If now one attempts to make the body touch a seventh point, either the body will not touch it, or one of the original six points will lose contact, or something will be deformed and will act as an impromptu spring. If the rigid body be, for example, the head of a micromanipulator, it is plain that restraining it in more than six points will be undesirable and will lead to erratic performance.

The above reasoning can be simply illustrated by considering a stool resting on a floor. If the stool has three legs it will have three degrees of freedom, e.g. it can be translated in two ways and rotated in one. But it will not rock, however far from flat the floor may be and regardless of any inequality in length of the legs. If we add a fourth leg, the stool will in general rock and at any one time rest on only three legs. The amount of this rock may be reduced by carefully making the floor surface spherical (or plane) and making the legs end on a plane. Of course, the rock can never

¹ Such an analysis of the problem of instrument design was first made by J. C. Maxwell, South Kensington Museum, Handbook to the Special Loan Collection of Scientific Apparatus, 1876, p. 3.

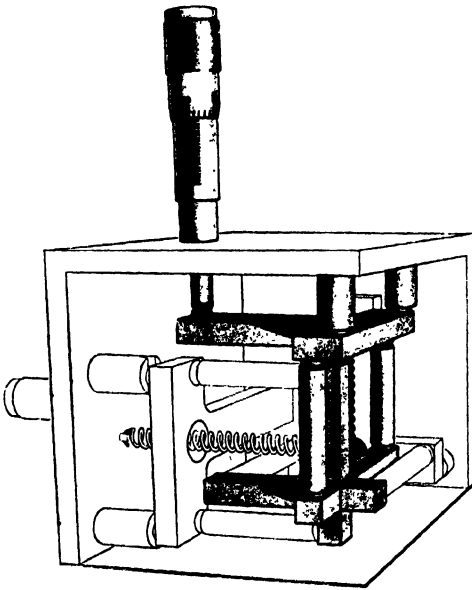


FIG. 1.

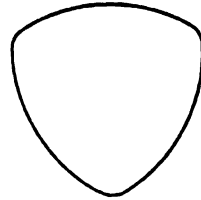
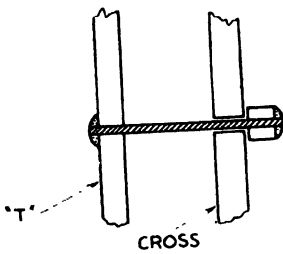





FIG. 2.



-  BRASS
 -  SOLDER
 -  BRONZE WIRE
- FIG. 3.

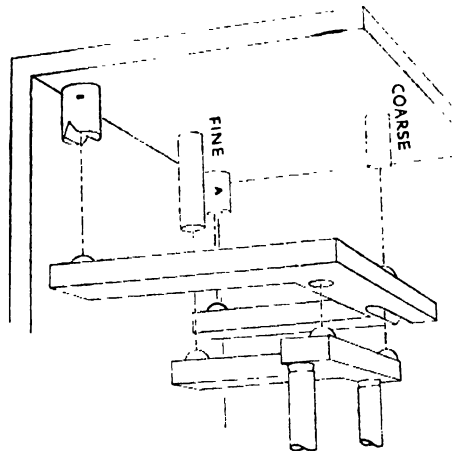


FIG. 4.

be made zero, but by sufficiently precise work it can be reduced as much as desired. However, the slightest non-uniformity of wear will nullify the effect of this precise work. Application of a load may apparently change the situation, because the stool may flex under load by an amount sufficient to make all the legs contact the floor. Even in this case it cannot be said that the stool is free from rock relative to the floor, because the exact manner of flexure will depend on the location of the weight on the stool. Thus a three-legged stool, no matter how crude the construction, rests firmly on any floor, while progressively better and better construction of a four-legged stool and associated floor only makes it less and less bad and never gets it really right.

Now our object is to design an instrument which, like the three-legged stool, will be inherently right and will not require careful machine work in its construction.

On the other hand, the ordinary slide, as used in microscope focusing adjustments, micromanipulators, etc., corresponds to a four-legged stool. Fortunately good machine work is now available at reasonable prices, and as a consequence slides are available that work very well. Nevertheless a satisfactory micromanipulator costs quite a bit and most of this goes for the careful machine work necessary if conventional slides, bearings, etc., are to give reasonably satisfactory performance. Also it is to be noted that wear will inevitably make these machines become loose.

At this point we will omit details of the reasoning which led to the final design chosen. It should be said, however, that this design is not unique; there are any number of designs satisfying the above principles. However, the present design is believed to be one of the neatest.

Fig. 1 shows the instrument with part of the cover removed. For clarity only parts associated with one direction of motion have been shaded; other directions are exactly symmetrical. Also the clamp which holds the needles has been omitted; it is an extension of one of the short arms of the cross. A few moments' inspection will lead to an understanding of the *modus operandi*. It will be noted that:

- (1) There is no possibility of lost motion or backlash.
- (2) No close fits are required.
- (3) Wear will not influence the performance.
- (4) All the micrometer screws are solidly fastened to the base.
- (5) There is a lever reduction of about 8-1 between each screw and the moving cross, so that the cross is easily moved by very small amounts.

In connection with (1) above, the following severe test was made. A microscope with an eyepiece scale was used to observe a quartz needle point. Then by turning one of the micrometer screws the point was moved until it coincided with a chosen graduation on the eyepiece scale. The micrometer reading was recorded. The process was then repeated, but with the needle approaching the chosen mark from the opposite side. It was found that the

average difference in micrometer settings was about one wavelength of light. This is a very small difference indeed, but we believe that even this can be eliminated by a slightly changed design. Moreover, this slight error comes out gradually during the first small motion of the needle and so does not give the appearance of backlash. That is, the slightest motion of the micrometer screw always results in a motion of the needle in the proper direction.

As to point (2), it is literally true that a micromanipulator of this type can be made by anyone using only a drill press, metal saw, soldering equipment, and the usual hand tools. One constructional point that may not be obvious relates to the various conical holes in which steel balls rest. These holes should really be "three-sided" rather than round. For this reason a two-lipped countersink should be used, as it will have a tendency to make a "three-sided hole" like that shown in Fig. 2. Three or four-lipped countersinks should not be used, as they tend to produce four- or five-sided holes which are definitely not correct. Another constructional point is the following; disasters due to momentary overloads pulling the cross out of contact with one or more of the six push rods and so precipitating a rapid disintegration may be avoided as shown in Fig. 3. Small bronze wires are easily installed, as shown there. In ordinary operation they do nothing, but when an overload is applied they keep things from coming far enough apart to allow pieces to fall out.

As a consequence of (4), placing the hand on one of the micrometer heads does not tend to make the needle move because of spring or lost motion in slides or hinges that lie between the screw in question and the base.

The lever reduction mentioned in (5) may not always be desirable. With 1-inch micrometer screws and 8-1 reduction the manipulator illustrated moves over a range of $\frac{1}{8}$ inch. Plainly greater travel can be obtained by changing the lever ratio and, of course, changing various dimensions to suit. If both a large travel and a very fine adjustment are desired, they may be obtained by the use of a modified design the essential part of which is shown in Fig. 4. Here there are two screws for each direction of motion, one giving fine adjustment, the other coarse. All the advantages of the simpler machine are retained.

The manipulator here described was made for Dr. C. V. Taylor of the Biology Department, Stanford University. He has used it more than a year now, and finds it very satisfactory.

XIV.—NOTES ON THE DISTORTION OF PARAFFIN SECTIONS.

By F. J. AUMONIER, M.Sc., F.R.M.S.

(Read November 16th, 1938.)

ONE TEXT-FIGURE.

DURING the course of some research on vertebrate embryology, it was necessary for the author to make several graphic reconstructions of the developing skull of *Lepidosteus osseus*. After a few reconstructions had been made, it was noticed that there was some distortion during the course of preparation.

At a later date Mr. H. K. Pusey, who has published details of a special system of reconstruction, drew the author's attention to a considerable distortion of the wax ribbon which occurred during section cutting, and persisted after "floating out."

In view of the importance of accurate reconstructions (either graphic or plastic) from serial sections, it was decided to pursue the matter further.

At first it was hoped that a fairly accurate estimate of distortion could be made and corrections applied from the published data. Unfortunately so many factors are involved and standardization of the conditions is so difficult, that this was impracticable; but it was felt that a publication of the results so far obtained would be of value, in as much as it would be an indication of the order of magnitude of the errors due to section cutting.

When a ribbon of paraffin sections is cut on a rotary microtome, it will be noticed that each section is of a creased or wavy appearance. These creases also vary greatly in size according to the thickness of the sections. When the ribbon is placed on warm water, the creases are smoothed away and the ribbon expands in length. The chief question to be answered is, Does it regain its full length?

Before answering the question it will be advisable to consider a few of the factors which might have an effect on the problem and the following were selected for study:

- (1) Consistency of wax (as measured by its melting-point).

- (2) Shape of block.
- (3) Sharpness of knife.
- (4) Angle of knife.

In order to test 1: Blocks were made of plain wax of 52° C. melting-point and another similar set of blocks of 58° C. melting-point.

Considerable difficulty was experienced in obtaining consistent results with hard wax, but the soft (52° C.) gave no trouble.

For the investigation of 2: Blocks were cast using brass L's, and the following dimensions were employed: (a) 19 mm. \times 20 mm.; (b) 19 mm. \times 5 mm. As a further experiment block *b* was cut in two different directions: (i) with its longer side parallel to the knife, (ii) with its longer edge at right-angles to the knife.

Block *a* was difficult to work with and required much space for its expansion; block *b* (i) was easy to manage and *b* (ii) was more difficult than (*a*). In order to give sufficient space for free movement of the ribbon, the sections were mounted on old photographic quarter-plates. These were cleaned in hot soap and water.

In dealing with block *a*, seven sections of 5 μ thickness were cut, then seven sections at 25 μ , and then seven more at 5 μ . This process was repeated for 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 20 μ . The two ribbons of 5 μ were mounted one on each side of the 25 μ ribbon and were floated out together. In order to maintain constant conditions for all the plates in one experiment, a standard quantity of 30 p.c. alcohol was placed on each quarter-plate, and the time of floating out was standardized at 5 minutes for 52° C. wax and 10 minutes for 58° C. The hot plate was the top of a thermostatically controlled embedding oven.

It was soon found that seven sections of the large block were far too big for a quarter-plate, in as much as they required a great deal of space in which they could surge about on the diffusion currents set up by the warming of the alcohol. It was obviously necessary to avoid actual contact between adjacent ribbons while expansion was taking place and also to avoid adhesion between a ribbon and the edge of the quarter-plate. The experiment was repeated first with five and then with three sections to a ribbon.

The total length of five, three and one sections respectively was then measured with a millimetre scale (it was found to be easier not to measure the length of a whole ribbon, but to exclude the end section). This resulted in a comparison between a control ribbon of 25 μ thickness and the experimental ribbon of a lesser thickness. It was not possible to obtain an absolute measurement which would have sufficient accuracy to be useful, but as the difference between 20 μ and 25 μ is slight, it can be assumed that the total error for 25 μ is not serious.

The results obtained from block *a* were not very consistent, but those from *b* (i) were excellent and reliable. In this case it was possible to cut ribbons of twelve sections and to measure a run of ten sections. The results were tabulated for each experiment and a graph was drawn from the details

of the tables. The following is an example of the tabular form used. It refers to an experiment with block *b* (i) in wax of 58° C. m.p.

5μ	..	..	C = 42.2	} 36 p.c.
			E = 27	
6μ	..	..	C = 42.2	} 35.1 p.c.
			E = 27.5	
7μ	..	..	C = 25.6 (6 secs.)	} 30.1 p.c.
			E = 30.7 or 28.7	
8μ	..	..	C = 38 (9 secs.)	} 27 p.c.
			E = 30 (or 31.5) for 10	
9μ	..	..	C = 42.5	} 24.7 p.c.
			E = 32	
10μ	..	..	C = 42.2	} 24.2 p.c.
			E = 32	
11μ	..	..	C = 42	} 20.5 p.c.
			E = 33.4	
12μ	..	..	C = 42.2	} 15.9 p.c.
			E = 34.5	
13μ	..	..	C = 42.5	} 15.3 p.c.
			E = 36	
14μ	..	..	C = 43.7	} 13 p.c.
			E = 38	
15μ	..	..	C = 46.5	} 11.3 p.c.
			E = 39	
20μ	..	..	C = 46.5	} 1 p.c.
			E = 46	

In dealing with block *b* (ii), it was found to be impossible to obtain a sufficiently straight ribbon for measurement and single sections were therefore measured. This is less accurate than the measuring of a row, but the results are reasonably close to those for *b* (i) and permit of the conclusion that the form of the block is not important.

When block *b* (i) in 58° C. m.p. wax was examined it was found that the distortion was within the limits of experimental error at 20μ, but for the thinner sections it showed much worse results than the 52° C. wax.

With regard to the sharpness of the knife, this was found to be the limiting factor in the whole series of experiments. The knife was reset for each experiment and great care was taken to ensure that the edge showed no nicks or any irregularity for at least 2 cm. length; generally it was of equal smoothness throughout.

It was often noticed that while the 25μ ribbon was straight, the 5–10μ ribbons might have a slight curvature. This curvature was permanent and could only be cured by shifting the knife so as to use a different length of cutting edge. It was evidently due to uneven sharpness in different parts of the edge.

in the embryo and would not vitiate results as to, for example, whether the stapelial artery ran dorsal or ventral to the columella ; but a study of the relative proportions of olfactory, cranial and auditory capsules might be more seriously affected. It is obvious that some of the great discrepancies between embryos of what is believed to be the same stage, but which have been cut in different planes, might be due to the distortion taking place in different directions.

The most important problem was to discover how far the distortion of the wax was transmitted to the tissue. Fortunately there is much less distortion of tissue than of the wax. The tissue selected for experiment was the distal loop of the duodenum of a frog. It has the following advantages :

- (i) it is straight and of a constant diameter for a reasonable length ;
- (ii) it has a smooth, circular outline in transverse section ;
- (iii) its consistency is not greatly different from a young tadpole or a fish larva.

CONCLUSIONS.

1. Sections should be cut as thick as possible.
2. Wax of a low melting-point should be used.
3. The greatest possible care should be bestowed upon the knife.
4. Wherever possible celloidin sections or double embedded material should be employed.

DESCRIPTION OF TEXT-FIG.

The ordinates of the graph represent the percentage loss in length of the experimental ribbons compared to a control ribbon of 25μ thickness. The abscissæ are the thickness in microns of the experimental ribbons.

Symbols. ● expresses the results obtained with a block of paraffin wax of 52° C. m.p. measuring 10 mm. \times 5 mm. and cut with its long edge parallel to the knife. The thicknesses cut were 5μ , $10\text{--}15\mu$ in steps of 1μ , and 20μ .

\times gives the results obtained from the same block after the knife had been reset and a further series of ribbons of from 5μ to 10μ in steps of 1μ had been cut.

⊙ This was a similar block, but cut with its long edge at right-angles to the knife. (The ribbons for 13μ and 14μ are missing.)

□ A similar experiment to ● and \times , but the block was of 58° C. m.p.

† A block of 52° C. m.p. after the knife had been used for a whole experiment on 58° wax. (Only ribbons for 5, 6, and 7μ were cut.)

△ This was a piece of the distal loop of a frog's duodenum embedded in 52° C. wax and the behaviour of the tissue was measured without regard to that of the wax.

ABSTRACTS AND REVIEWS

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE.

Localization of Iron in Tissues.—K. V. OKAMOTO ("Über das Gewebseisen," *Actae Schol. Med. Univ. Imp. Kioto.*, 1937, 20, 3, 413-560). The author describes a modification of former methods for the "unmasking" and histochemical demonstration of bound iron in tissues. Smears or sections are suspended for 12-24 hours over a solution of ammonium ferrosulphate (30-40 gm.) in 5 p.c. sodium chloride (100 c.c.), to which a small quantity of sulphuric acid is added. The iron liberated is demonstrated by the Berlin blue reaction, and the tissue may then be counterstained in eosin. Great care must be exercised that none of the reagents (alcohol for fixing, benzol for cleaning, etc.) contain iron. Tissues from a series throughout the entire animal kingdom, from protozoa to mammalia, were investigated by means of this reaction and also by the Turnbull blue reaction for hæmosiderin. It was found that almost all animals in which hæmoglobin is present contain iron localized mainly in the nuclei of their tissue cells, whereas in animals lacking hæmoglobin iron is present as hæmosiderin and not as nuclear iron. In the mammalia more detailed study showed that cells of almost all organs contain iron in their nuclei, with the exception of nerve cells, smooth muscle, and stratified epithelium.

T. J. M.

Preservation of Anatomical Specimens.—J. R. PATE (*Science*, 1938, 87, 586). Cadavers have been preserved for varying periods of time, from several months to a year or more, in equal parts of 95 p.c. alcohol, phenol and glycerine to which a small quantity of formalin has been added, approximately 1 pint to 5 gallons of the above solution. Groups of muscles, leaving the origin and insertion of the bones with nerves and bloodvessels, are dissected out, dried for from 8 to 24 hours, and then sprayed once or twice with the following solution: 1 part of formalin, 3 parts of 95 p.c. alcohol and 2 parts of white shellac, allowing each coat to dry before the next is given.

G. M. F.

A Rapid Impregnation Method of Microglia and Oligodendroglia.—L. S. KING ("Method for rapid impregnation of Microglia and Oligodendroglia in Material fixed in Formaldehyde," *Arch. Neurol. Psychiat.*, 1937, 66, 362-4). Sections cut on the freezing microtome at 20-40 μ are placed immediately in water containing 20 drops of ammonia in 100 c.c., thence directly into a solution of 5 p.c. ammonium bromide and heated for from 10 to 15 minutes in the paraffin oven at 40°-50° C. Sections are then placed in Hortega's mixture of equal parts of ammonia, pyridine and water for 2 minutes or a little longer, followed by immersion

for 2 or 3 minutes in a freshly prepared 3-5 p.c. solution of sodium sulphite. Sections are next carried directly into Hortege's silver carbonate solution, consisting of sodium carbonate, 5 p.c. solution, 8 parts; silver nitrate, 10 p.c. solution, 2 parts, ammonia being added till the precipitate dissolved; distilled water 5 parts. Three glasses of the solution each containing 10 c.c. are prepared and sections are carried through all three, remaining in each less than a minute, and shaking well. Sections are then reduced in 1 p.c. formalin for less than a minute, washed and mounted.

G. M. F.

A New Slide Warmer.—A. M. SCHECHTMAN ("A Simple Inexpensive Slide Warmer," *Stain Technol.*, 1938, 13, 137-8, 2 text-figs.). The slide warmer is an elongated box 18 inches long of three-ply wood covered with a sheet of window glass on which are placed the slides to be heated. Heat is derived from three evenly spaced 10-watt electric bulbs, arranged in parallel. Above the bulbs is a thin galvanized plate (baffle) perforated in the regions between the bulbs so as to distribute heat evenly. The temperature of the warmer varies from 41° to 43° C.

G. M. F.

Photomicrography of Large Transparent Sections.—J. V. BUTTERFIELD. ("An Illuminating System for Large Transparent Sections in Photomicrography," *J. Biol. Photogr. Ass.*, 1938, 6, 155-61, 9 figs.). For low-power photomicrography a 3-lens condenser is described to provide a uniformly illuminated field of about 3.75 inches diameter. A ribbon filament or arc lamp is used and a special stage for large brain sections, the whole being fitted on to the optical bench of the photomicrographic camera.

G. M. F.

A Method of determining in vitro whether the Bacillus of Rat Leprosy is alive or dead.—R. O. PRUDHOMME ("Moyen de reconnaître *in vitro* si le bacille de Stéfansky est mort ou vivant," *Ann. Institut Pasteur*, 1938, 61, 512-18). The bacillus of rat leprosy separated from all traces of tissue decolorizes solutions of 1-naphthol-2-sodium sulphonate-endo-2-6-dibromophenol, 0-cresol-2-6-dichlorophenol, and 0-chlorophenol-endo-2-6-dichlorophenol. If killed by heating at 100° C. for 15 minutes it does not decolorize these indicators: 1 p.c. formol for 15 minutes or ultra-violet light for 10 minutes kills the bacilli.

G. M. F.

Staining Paraffin Sections with Protargol.—H. A. DAVENPORT and C. L. KLINE ("Staining Paraffin Sections with Protargol. 1. Experiments with Bodian's Method. 2. Use of *N*-Propyl and *N*-Butyl Alcohol in Hofker's Fixative," *Stain Technol.*, 1938, 13, 147-160, 2 pls.). Paraffin sections of nervous tissue, fixed in Hofker's fluid, stain readily with protargol solution without the addition of metallic copper or other activator. Tissues were fixed in the following modification of Hofker's mixture: formic acid 5 c.c., trichloroacetic acid 10 gm., *n*-propyl alcohol 20 c.c., and *n*-butyl alcohol 60 c.c. (in place of the acetic, trichloroacetic, ethyl alcohol mixture). Fix for 12-24 hours, pass to water through graded ethyl alcohol, wash several hours, dehydrate and embed in paraffin. Section, remove paraffin, pass to water and impregnate for 2 or 3 days at 27°-30° C. in an 0.5 p.c. aqueous solution of protargol (Winthrop Chemical Co.). Rinse 2 or 3 seconds and reduce with 0.5 p.c. amidol (Agfa brand) in 5 p.c. sodium sulphite solution. Wash, tone with 0.1 p.c. gold chloride, wash and reduce with 0.5 p.c. amidol without sulphite; wash, dehydrate, and mount. The method works well on spinal nerve roots, cerebrum, cerebellum, and spinal cord, and rather less satisfactorily on nerve trunks including sympathetic nerves.

G. M. F.

Alizarin Red S for Elasmobranch Skin.—P. SAYLES ("Alizarin Red S Technic applied to Elasmobranch Integument," *Stain Technol.*, 1938, 13, 143-4). Large pieces of skin of the dog-fish, *Squalus acanthias*, are removed from the body with a minimum of subcutaneous tissue. These are soaked in water for 1-3 days to remove adherent connective tissue. The skin, without preliminary treatment in alkali, is placed in a large amount of an aqueous solution, 0.4 p.c. of alizarin red S solution. The length of time in the stain is usually 2-3 hours, but if there is over-staining soaking in ammonia 1 part to water 9 parts will remove the excess. After washing in water the skin is transferred through 50 and 70 p.c. alcohols to 95 p.c., where it is left for 12 hours; clearing is carried out in methyl salicylate, or preferably in 1 part of 95 p.c. alcohol to 5 parts of salicylate. G. M. F.

Swelling of the Brain in Buffer Solutions.—H. SELBACH ("Über Volumänderungen des Gehirngewebes in Pufferlösungen verschiedener pH. *Z. gesamt. Neurol. Psychiat.*, 1938, 162, 145-9). Portions of rabbits' brain, about 250 mgm., were placed in a series of Sørensen's phosphate buffer mixture (pH 6.0-8.3). The least swelling occurred at pH 7.4, was more rapid on the alkaline side of neutrality, a maximum being reached in 2-3 hours, while on the acid side a similar maximum is only reached after 6 hours. G. M. F.

Eliminating Electrification from Paraffin Ribbons.—R. J. BLANDAU ("A Method of Eliminating the Electrification of Paraffin Ribbons," *Stain Technol.*, 1938, 13, 139-41, 1 text-fig.). The following cheap apparatus eliminates the electrification of paraffin ribbons. A Ford T-TT induction coil is connected with two 4-inch brass or copper strips; to the end of one strip is soldered a copper disc 1.5 inches in diameter and covered with heavy tinfoil. To the second strip is soldered one-half of a similar disc and its surface is also covered with several layers of tinfoil. The tinfoil should extend 0.25 inches beyond the straight edge of the half circle copper plate. The foil extending is cut to present 15 or 20-pointed projections. The coil is supplied with current from a toy train transformer yielding 5-12 volts or 4-6 amps. When the coil is in operation the two discs should be moved apart to a distance just beyond which the spark fails to jump. The apparatus is so set that the two brass strips are parallel to and an inch or two above the microtome knife. A bell push-button may be inserted into the circuit so that the operation of the apparatus may be controlled by the foot, leaving the hands free to handle the ribbon. G. M. F.

Wright's Blood Stain for *Trichomonas foetus*.—H. M. STEWART ("The Staining of *Trichomonas foetus* Riedmüller with Wright's Blood Stain," *J. Parasitol.*, 1938, 24, 473). Smears of material may, if required, be dried in air, but fixation with osmic acid fumes is preferable. Smears are covered with 5 drops of Wright's stain to which are added immediately 15 drops of Sørensen's buffered solution with a pH of between 7.0 and 7.6. Allow to stand for 2 minutes, wash off with the same buffered solution, and dry in air. The cytoplasm of *T. foetus* is stained light blue, the posterior part of the axostyle pink, the flagella pink, and the nucleus, blepharophasts, and chromatin ring round the posterior portion of the axostyle dark purple. G. M. F.

Preparation of Giemsa's Stain.—C. BESSLER ("Per la preparazione della soluzione colorante Giemsa," *Riv. Malariol.*, 1938, 17, 162-3). The following preparation is recommended: 3.0 gm. of azur-eosin methylene blue (Merck) are dissolved in a dark coloured bottle in 375 c.c. of pure acetone-free methyl alcohol (Merck) and 125 c.c. of doubly distilled glycerine (Merck) is added. The mixture is kept at

37° C. for 14 days, being shaken once daily and then kept at room temperature for 14 days, being filtered into a dark glass-stoppered bottle before use. The diluting fluid consists of monopotassium phosphate 1.0 gm., dipotassium phosphate 2.0 gm. dissolved in 1 litre of distilled water, 0.4 c.c. of the stain is added to 10 c.c. of distilled water. G. M. F.

Staining Thick Films : Removal of Hæmoglobin with Isotonic Solution.

—E. J. PAMPANA ("Colorazione dei preparati a goccia spessa : demoglobinnizzazione con soluzioni isotoniche," *Riv. Mal.*, 1938, 17, 300–4). In order to remove hæmoglobin from dried thick films hypotonic solutions are unnecessary, as isotonic sodium chloride and even hypertonic solutions give rise to perfect hæmolysis. For staining thick preparations Giemsa's stain should be diluted 1 : 20 with a phosphate buffer solution, equimolecular to 0.85 p.c. normal saline and of a pH 7.2. This gives a colourless clear background and a sharp outline to malarial parasites and white cells, the nuclei of which retain their normal shape. G. M. F.

Drying Thick Blood Films.—M. D. YOUNG ("A Rapid Method for drying Thick Blood Films," *Publ. Hlth. Rep.*, 1938, 53, 1256–7). On very humid days a thick film may require over an hour to dry. An ordinary hot-air hair-dryer is held at a distance of about 2 feet above the film. The heated air is directed against the films. Films under the hair-dryer take about one-tenth the time required for films under ordinary room conditions. G. M. F.

A New Method of Staining Thick Films.—H. SIMONS ("Nouvelle méthode de coloration et de diagnostic des protozoaires sanguicoles dans les gouttes épaisses (saponine-bleu de méthylène)," *Bull. Soc. Path. exot.*, 1938, 31, 100–6). The following mixture removes the hæmoglobin by means of the saponin and stains the parasites and leucocytes by methylene blue : methylene blue 0.6 gm., sodium chloride 1.8 gm., sodium citrate 3.0 gm., saponin 2.0 gm., formol (15 p.c.) 12 c.c., distilled water 300 c.c. The mixture is poured over a thin or thick film and allowed to act for 1 or 2 minutes, while with thick films the stain is removed and fresh stain applied for three to five times. When staining is complete the last lot of stain is drained off and a cover-glass applied direct, without drying. G. M. F.

Saponin Methylene Blue.—H. SIMONS ("Nouvelles applications du mélange colorant saponine-bleu de méthylène à l'étude des protozoaires sanguicoles," *Ann. Parasit.*, 1938, 16, 334–40). On mixing 1 part of blood and 5–10 parts of the colouring solution in test-tubes for 12 hours trypanosomes and spirochaetes present in the blood form an agglutinated coloured mass. The same colouring solution can be used for leptospira, piroplasms, blood platelets. G. M. F.

An Error in counting Leucocytes.—J. ENGELBRETH-HOLM and C. SMITH ("A Source of Error in the White Blood Count," *Acta Med. Scand.*, 1938, 95, 129–35, 2 text-figs.). If blood diluted with Türk's solution for leucocyte counts is left standing, the number of leucocytes decreases. Formalin, 5–10 p.c., or 1 p.c. sodium fluoride may decrease the fall but the most satisfactory was a saponin-fluoride solution (saponin 0.2 gm., methyl violet 0.1 gm., sodium fluoride 2 gm., distilled water 200 c.c.). With this mixture the decrease in the leucocyte count did not exceed 1 p.c. in 24 hours. A fine precipitate may occur in the counting chamber, but does not interfere with the enumeration of the leucocytes ; the mixture must be kept in a paraffin-lined bottle or made up freshly at short intervals, as fluoride is lost in glass containers. G. M. F.

Preparations from Rapid Cytological Techniques.—B. B. HILLARY, ("Permanent Preparations from Rapid Cytological Technics," *Stain Technol.*, 1938, 13, 161-7, 4 text-figs.). Insect salivary gland chromosome smears can be made by crushing the glands under a cover-slip in Belling's aceto-carmine on a slide coated with dried egg albumen. After 20 minutes the area around the cover-slip is flooded with 50 p.c. acetic acid and the cover-slip floats loose so that it can be removed. The slide is flooded with dioxan, followed by two changes of dioxan for 2 minutes each. A drop of Canada balsam dissolved in dioxan is added and a cover-slip applied. A similar technique is used for pollen mother-cell smears and squash preparations of root-tips after application of the Feulgen technique. G. M. F.

Intravital Staining of Cell Lipins.—A. HADJIOLOFF ("Coloration intravitale des lipides cellulaires chez les animaux. II. La voie panentérale. Importance biologique de la coloration intravitale des lipides," *Bull. Histol. Appl.*, 15, 113-29). Fat soluble dyes of the Sudan-Scharlach group were injected into the lymph sacs of frogs, dissolved in absolute alcohol or acetone. The dye coloured adipose tissue intensely and was taken up by the reticulo-endothelial cells. Connective tissue cells were stained only after very heavy doses, but epithelial and nervous cells were unstained. G. M. F.

Methyl Green as a Stain for the Zymogen Granules of the Pancreas—J. KREMER ("Eine einfache und empfehlenswerte Methylgründoppelfärbung des Kaltblüter-pankreas mit besonderer Hervorhebung der Zymogengranula," *Z. wiss. Mikrosk.*, 1938, 54, 419-20, 4 figs.). Zenker-fixed material is stained in methyl green N, 1 gm. being dissolved in 100 c.c. of distilled water in 0.25 c.c. of phenol. The secretory granules in the pancreas may be differentiated with methyl green containing 1.0 p.c. pyronin. G. M. F.

An Aqueous Mounting Medium.—C. R. MONK ("An Aqueous Medium for mounting Small Objects," *Science*, 1938, 88, 174). For mounting parts of small marine copepods the following mixture has been found of value: white Karo syrup 5 c.c., Certo (fruit pectin) 5 c.c., and water 3 c.c. A gram of powdered fruit pectin dissolved in about 10 c.c. of water by boiling may be used instead of Certo. A crystal of thymol is added as preservative. A small drop of the mixture is taken up with a fine needle and spread on a clean slide and the desired parts are arranged in it. The mixture "sets" in about 2 minutes and holds the parts firmly in position. The mount is dried to hardness over heat. G. M. F.

Staining *Treponema pallida*.—R. D. HAIRE ("A practical Method of Staining *Treponema pallida* by Means of Low Surface Tension Stain," *J. lab. clin. Med.*, 1938, 23, 1215-16, 1 text-fig.). The penetrating power of any liquid is increased as the surface tension is lowered: this explains the penetrating power of hexylresorcinol solution. A stock solution of 1 p.c. gentian violet is made by placing 1 gm. of powdered stain in a small mortar and while mixing slowly adding 100 c.c. of hexylresorcinol. This is then filtered and put into a stock solution bottle ready for use. The stain is applied for 30 minutes: the smear is next washed in water, dried in air and examined. *Treponem pallida* is found to stain a light purple on a faintly purple field. Bacteria, pus cells, and epithelial cells also take a light purple stain. Under no condition must the stain be heated on the slide, as this promptly removes the smear. G. M. F.

Demonstration of Ultraviruses and Other Microbes by Fluorescence.—P. K. H. HAGEMANN ("Fluorezenzmikroskopische Untersuchungen über Virus und andere Mikroben," 17 *Tag. d. deut. Verein f. Mikrobiologie*, in *Zbl. Bakt.*, Abt. I,

Orig., 1937, 140, 184). Fluorescent substances were mixed either in smears, culture media, or *in vivo* with a number of micro-organisms which can then be detected by their fluorescence when exposed to ultra-violet light. Tubercle bacilli can thus be found in the sputum, pus, or cerebro-spinal fluid, spirochætes and trypanosomes in the blood. A number of viruses—ectromelia, vaccinia, molluscum contagiosum—can also be observed by this method. The invisibility of certain ultraviruses is due, according to the author, not to their size but to the fact that they do not absorb fluorescent substance or that they are contained in a medium which absorbs fluorescent substances with such intensity that the fluorescent image does not stand out.

G. M. F.

A Cytological Change in Malignant Cells.—G. ROSKIN ("Sur le diagnostic cytologique différentiel des cellules cancéreuses," *Bull. Histol. appl. Physiol. Path.*, 1938, 15, 20–23). Cells, not necessarily all malignant, from a number of tumours were unable to take up a methylene blue stain when bathed in the leucobase of that dye. The leucobase is prepared from a slightly acidified 5 p.c. solution of the dye by the addition of 3 gm. of rongalite to 10 c.c. of the dye solution, which is then heated cautiously till decolorized. The pH of the solution must not go below 2.41.

G. M. F.

Sudan Black B as a Fat Stain.—E. H. LEACH ("Fat staining with Sudan Black B," *J. Path. Bact.*, 1938, 47, 635–7). Tissues should be fixed for 24 hours in 5 p.c. formaldehyde in 0.9 p.c. saline or in Zweibaum's fixative which consists of A : 6 c.c. of 3 p.c. potassium bichromate, 3 c.c. of 2 p.c. chromic acid, and 5 c.c. of distilled water ; B : 2 p.c. osmium tetroxide, 7 parts of A to 1 part of B. In either case fixation is followed by washing for 24 hours in running water, when tissues are either cut frozen or embedded in gelatin by Aschoff's method. Sections are transferred from water to 50 p.c. diacetin for 30 seconds with shaking, and then placed in a saturated solution of 50 p.c. diacetin for from 15 minutes to 1–2 hours. The solution of dye is made by adding excess of dye to equal volumes of distilled water and diacetin. The solution made in a glass-stopped bottle is placed in a 55° C. thermostat for 2 days and allowed to cool. Before use the amount of solution required is filtered off. After staining sections are placed in 50 p.c. diacetin for 30 seconds and then in a bowl of clean water in which they spin on the surface and flatten out. They are floated on to a slide and mounted in Apathy's medium. Counterstaining with carmalum can be carried out before passing to water. Nuclei are stained red ; lipins, including myelin, an intense blue black.

G. M. F.

Staining Mucin.—E. H. LEACH ("A New Stain for Mucin," *J. Path. Bact.*, 1938, 47, 637–9, 1 pl.). If sudan black B is allowed to stand for several months in a mixture of equal parts of diacetin and water, hydrolysis of the diacetin occurs and the sudan black B no longer stains lipins, but in both paraffin and frozen sections stains mucin. Hydrolysis of sudan black B with acetic acid also produces a solution that stains mucin. The constitution of the dye is at present unknown ; it is proposed to call it "mucisudan." To prepare a solution add 2 gm. of mucisudan to 100 c.c. of a 0.5 p.c. solution of hydrochloric acid in 70 p.c. alcohol ; allow to stand for at least 2 days on a hot plate and filter. The best fixative is Zenker-formaldehyde ; tissues are embedded in paraffin, sectioned, and sections taken down to water ; mucisudan in acid alcohol is allowed to act for 1 hour, then into acid-alcohol for a few minutes, counterstain in carmalum : mucin, cartilage, and occasionally elastic fibres stain dark brown, nuclei red.

G. M. F.

Cytology.

The Action of the Golgi Apparatus of Liver Cells on Dyestuffs, Pigments, and Lipoids.—W. PFUHL and O. DIENSTBACH ("Die Speicherung und Verarbeitung von kolloiden Farbstoffen, Pigmenten und Lipoiden in der Golgi-Substanz der Leberzellen," *Z. Anat. u. Entwgesch.*, 1938, **108**, 260–82). Liver cells take up trypan blue, lithium carmine and collargol, when injected as intra-vital stains, to a different degree in different species, as in rabbits and guinea-pigs the uptake is rapid and strong, while in mice and rats it is much less, and in dogs the cells are quite refractory. With moderate staining the dye appears in the Golgi apparatus in the form of granules but with larger amounts the whole Golgi apparatus is stained. G. M. F.

Phagocytic Activity of Human Leucocytes.—A. J. HERTZOG ("The Phagocytic Activity of Human Leucocytes with Special Reference to their Type and Maturity," *Amer. J. Path.*, 1938, **14**, 595–604, 1 pl.). Mature polymorphonuclear leucocytes showed the greatest amount of phagocytosis, both as to the number of bacteria ingested per cell and the percentage of cells engulfing bacteria. The monocytes, eosinophils and metamyelocytes were also actively phagocytic. The phagocytic activity of the myelocytes, promyelocytes, leucoblasts and myeloblasts appears to be directly proportional to the maturity of the cell, as in the more immature forms phagocytosis was decreased. The histoid stem cell and histoid monoblast of leucæmic reticuloendotheliosis were exceptional, as they showed an unusual degree of phagocytosis. Phagocytosis was observed in a small percentage of mature lymphocytes. G. M. F.

The Histiocytes observed in Inflammatory Lesions and in the Course of Immunity Reactions.—A. PEYRON, G. POUMEAU-DELILLE and P. MERCIER ("Sur l'origine et la signification des diverses variétés d'histiocytes observés dans les lésions inflammatoires et au cours des réactions d'immunité," *C. R. Acad. Sc.*, 1938, **206**, 2008–10, 1 text-fig.). Aseptic inflammation produced by injection of turpentine or diphtheria toxin is followed by a transformation of fibroblasts into histiocytes and is not a property of the reticulo-endothelial system or of the mononuclear cells of the blood. In immunized animals the histiocytes are derived chiefly from mononuclear cells of the blood. G. M. F.

Rotatoria.

Drilophaga delagei de Beauchamp.—L. K. PAWLOWSKI ("Beitrag zur Anatomie und Biologie von *Drilophaga delagei* de Beauchamp," *Arch. d'Hydrobiol. et d'Ichty*, 1935, **9**, 1–30, 2 pls., 3 text-figs.). The ectoparasitic Rotifera forming the subject of this study were obtained primarily from material collected in the district of Ldzan, Poland and were subsequently cultivated in aquaria, where the infection of the hosts was greater than in the natural habitat. Though six species of leeches were present, the Rotifera occurred only on *Herpobdella octoculata* and *H. testacea*. The author's examination showed that attachment to the host was always effected by means of the mastax and he is convinced that the species is truly parasitic. A. E. H.

Moss-dwelling Rotifera of Poland.—L. K. PAWLOWSKI ("Materialien zur Kenntnis der moosbewohnenden Rotatorien Polens. I," *Ann. Mus. Zool. Polon.*, 1938, **13**, 12, 115–59, 1 pl., 24 text-figs.). The material studied was collected in various districts in Poland during the years 1932 to 1937, and it yielded a total of 103 species distributed thus: Ploima, sixty-two, Rhizota, one, Bdelloida, forty.

The points of origin of each species are shown and a table gives the distribution according to districts and the nature of the moss at the habitats. One new species in each of the genera *Cephalodella* and *Dicranophorus*, together with a new form of *Habrotrocha crenata* Murray, are described.

A. E. H.

New British Rotifera.—W. E. GARNER ("Two New Species of Rotatoria," *J. Quek. Micr. Club*, 1937, 1, 7, 280-3, 2 pls.). The genus *Macrotrachela* receives a novel addition by the discovery of a species, *M. fungicola*, living amongst and nourishing itself upon the fungus *Dacromyces deliquescens*. It is oviparous and is very rapid in its movements. *Eosphora gibba*, which bears a superficial resemblance to *Pleurotrocha petromyzon* Ehr., apparently lacks the eyespots found in other species of the genus.

A. E. H.

Male of *Elosa worrallii* Lord.—W. E. GARNER ("A Description of the Male of *Elosa worrallii* Lord," *J. Quek. Micr. Club*, 1937, 1, 7, 284-6, text-fig.). Unlike the female of this species the male is furnished with a foot and a single toe. Digestive organs are absent.

A. E. H.

***Lindia janickii* Wiszniewski.**—W. E. GARNER ("Note on *Lindia janickii* Wiszniewski," *J. Quek. Micr. Club*, 1938, 1, 1, 12-13, 1 pl.). The supposition that this species is peculiar to a sandy environment is made somewhat doubtful by the discovery of examples in the Pen Ponds, Richmond Park, London. These ponds contain no sand but the bottom is decidedly muddy, and it is to be noted that the original description states that "l'espèce *L. janickii* est particulière avant tout aux plages souillées." Specimens were measured up to 350 μ in length; the auricles are briefly described.

A. E. H.

Protozoa.

Human Protozoa in Los Angeles.—J. F. KESSEL and D. SINITSIN ("A Survey of Intestinal Protozoa among Children and Adults in Los Angeles," *Journ. Parasitol.*, 1938, 24, 433-6). Report on the incidence of intestinal protozoa in the population of Los Angeles (total examined 345). In general it was found that the incidence in the middle age group was higher than in children or in older adults. In the adult the incidence in both sexes is similar, whereas in the juvenile group it is higher in males. The incidence of *Entamoeba histolytica* is higher in males than in females of all groups. *Giardia* is more common in children than in adults.

C. A. H.

Structure and Development of *Amœba*.—C. HAYES ("An Account of *Amœba discoides*; its Culture and Life-history," *Quart. Journ. Micr. Sci.*, 1938, 80, 459-78, 2 pls., 6 text-figs.). An account is given of the structure and development of *Amœba discoides*, with special reference to the nucleus and its division. Multiplication proceeds as follows: chromatin masses from the nucleus of the full-grown *amœba* are given off into its cytoplasm, some of which becomes differentiated around them. When the parent-*amœba* disintegrates the *amœbulae* are set free into the water, where they remain encysted for some time, eventually hatching and growing into adult forms.

C. A. H.

Effect of Centrifuging upon *Amœba*.—B. N. SINGH ("The Cytology of *Amœba proteus* 'Y' and the Effects of Large and Small Centrifugal Forces," *Quart. Journ. Micr. Sci.*, 1938, 80, 601-35, 2 pls., 2 text-figs.). One of the objects of centrifuging protozoa is to determine whether the various cytoplasmic inclusions represent pre-existing bodies or artifacts produced as the result of fixation. In this

paper an account is given of the cytology of *Amœba proteus* after subjecting it to centrifugation with an electrical centrifuge (5000 r.p.m.). The stratification of the cellular components, their appearance and identification are described in detail.

C. A. H.

Golgi Apparatus in Flagellates.—J. B. GATENBY and B. N. SINGH ("The Golgi Apparatus of *Copromonas subtilis* and *Euglena* sp.," *Quart. Journ. Micr. Sci.*, 1938, **80**, 567–91, 3 pls., 9 text-figs.). Description of a Golgi apparatus in *Copromonas* and *Euglena*, consisting of osmiophil material in the form of granules which are associated with the osmo-regulatory mechanism of the cell. By absorption of water the granules are transformed into vacuoles, previously regarded as contractile vacuoles. The behaviour of the Golgi apparatus during and following division and in the course of conjugation and encystment is also described.

C. A. H.

Venereal Trichomoniasis in Cattle.—(1) C. W. REES ("Bovine Venereal Trichomoniasis," *North Americ. Veterinarian*, 1938, **19**, [n.p.]); (2) C. W. REES ("Observations on Bovine Venereal Trichomoniasis," *Vet. Med. (U.S.A.)*, 1938, **33**, 16 pp. [sep. pag.]). Both papers are devoted to the flagellate *Trichomonas foetus* parasitic in the genital tract of both male and female bovines. An account is given of the flagellate, its cultural characteristics and the method of transmission. The disease is described as it occurs in both sexes, with data based on personal observations. The infection interferes with the œstrus cycle and delays or prevents conception; it may also cause death of the foetus. It is held that concomitant bacteria or viruses may co-operate with the trichomonad to produce some of the symptoms.

C. A. H.

Protozoa from Beetle Larva.—S. A. KOWALCZYK ("A Report on the Intestinal Protozoa of the Larva of the Japanese Beetle (*Popillia japonica* Newm., Coleoptera)," *Trans. Amer. Micr. Soc.*, 1938, **57**, 229–44, 2 pls.). Description of the following intestinal protozoa from the larvæ of the beetle *Popillia japonica* found in U.S.A.: *Retortamonas phyllophagæ*, *Monocercomonas mackinnoni* sp.n., *Monocercomonoides melolonthæ*, *Tetratrichomastix mackinnoni* sp.n., *Polymastix melolonthæ*, *Endamœba* sp., *Endolimax* sp., and *Actinocephalus* sp.

C. A. H.

Study of Cochlosoma.—B. V. TRAVIS ("A Synopsis of the Flagellate Genus *Cochlosoma* Kotlan, with the Description of Two New Species," *Journ. Parasitol.*, 1938, **24**, 343–51, 1 pl.). An account of the structure and systematics of the Polymastigine flagellates of the genus *Cochlosoma*, parasitic in the intestine of birds. *Cochlosoma rostratum* Kimura is believed to be a synonym of *C. anatis* Kotlan. To this the author adds two new forms: *C. pica* sp.n. from the American magpie, *Pica pica hudsonia*, and *C. turdi* sp.n. from the Eastern robin, *Turdus m. migratorius*.

C. A. H.

Ovine Coccidia.—J. F. CHRISTENSEN ("Species Differentiation in the Coccidia from the Domestic Sheep," *Journ. Parasitol.*, 1938, **24**, 453–67, 1 pl.). A systematic survey of the coccidia occurring in sheep, based on the examination of 100 animals. Size, shape, colour, sporulation time, and morphology of the unsporulated oocyst were the criteria used for the identification of species. After a description of the methods of examination an account is given of the structure of the oocyst. A key is provided for the differentiation of the species of ovine *Eimeria* by the characters of the oocysts. This is followed by a brief description of the seven species recognized by the author, the following two being new forms: *E. pallida* sp.n. and *E. granulosa* sp.n.

C. A. H.

Immunity in Coccidiosis.—N. F. MOREHOUSE ("The Reaction of the Immune Intestinal Epithelium of the Rat to Reinfection with *Eimeria nieschulzi*," *Journ. Parasitol.*, 1938, **24**, 311–7). Experiments were conducted with the object of ascertaining the duration of infection of rats with the coccidium *Eimeria nieschulzi*, and of studying the immunity resulting from such infection. The latter problem was investigated by reinfesting rats proved to be negative after a previous infection. Immunized rats were found not to harbour a latent infection. After reinoculation intracellular development of the coccidium did not take place in such rats. It is held that sensitization of epithelial cells provides an unfavourable environment for the parasite, but is not a factor in the immunity. The absence of sporozoites within the epithelial cells of immunized rats seems to indicate that immunity is the result of blocking of the entrance to sporozoites. C. A. H.

Leucocytozoon : Synonymy.—C. M. HERMAN ("*Leucocytozoon anatis* Wickware, a Synonym for *L. simondi* Mathis and Leger," *Journ. Parasitol.*, 1938, **24**, 472–3). A comparison of *Leucocytozoon anatis* Wickware, 1915, with *L. simondi* Mathis and Leger, 1910, both from ducks, has shown that they are morphologically indistinguishable and hence systematically identical; therefore the former name becomes a synonym of the latter. C. A. H.

Californian Myxosporidia.—E. R. NOBLE ("Two New Myxosporidia from the Tide Pool Fishes of California," *Journ. Parasitol.*, 1938, **24**, 441–4, 1 pl.). Description of two new species of Myxosporidia from Californian fishes: *Leptotheca elegans* sp.n. from spotted kelpfish, *Gibbonsia e. elegans*, and *Ceratomyxa blennius* sp.n. from blenny, *Hypsoblennius gilberti*. C. A. H.

Viability of Myxosporidian Spores.—F. F. BOND ("Resistance of Myxosporidian Spores to Conditions outside of the Host," *Journ. Parasitol.*, 1938, **24**, 470–1). Working with the spores of Myxosporidia, *Myxosoma funduli*, *M. subtecalis*, *Myxobolus bilineatus* and *Myxidium folium*, obtained from teased-up tissues of the fish *Fundulus heteroclitus*, the author conducted a series of experiments with the object of determining the length of time during which they persist outside the host. The extrusion of the filament, rounding and vacuolation of the cytoplasm and pyknotic degeneration of the nuclei of the spores were used as criteria of viability. In spores kept in saline or water, degeneration occurred between the 12th and 28th day, according to the species. C. A. H.

Histopathology of Myxosporidian Infection.—R. F. NIGRELLI and G. M. SMITH ("Tissue Responses of *Cyprinodon variegatus* to the Myxosporidian Parasite *Myxobolus lintoni* Gurley," *Zoologica*, 1938, **23** (2), 195–202, 7 pls.). A redescription is given of the myxosporidian *Myxobolus lintoni* and of its development in *Cyprinodon variegatus* (Pisces), in which the parasite produces surface tumours. An account is given of the histo-pathological changes in the host tissue due to the infection. C. A. H.

Microsporidia in Termite.—R. R. KUDO ("A Microsporidian Parasitic in *Reticulitermes flavipes*," *Journ. Parasitol.*, 1938, **24**, 377, 1 fig.). This is the second record of a microsporidian from termites. The present parasite, a *Nosema*, lives in the intestine of *Reticulitermes flavipes*, U.S.A. A brief description of the structure of the spores is given. C. A. H.

Sarcosporidia in Ducks.—C. GOWER ("A New Host and Locality for *Sarcocystis rileyi* (Stiles, 1893)," *Journ. Parasitol.*, 1938, **24**, 378). Report of the finding of *Sarcocystis rileyi* in N. American ducks, one of which, *Anas rubripes*, has not previously been known to harbour Sarcosporidia. C. A. H.

Cannibalistic Ciliate.—A. C. GIESE ("Cannibalism and Gigantism in *Blepharisma*," *Trans. Amer. Micr. Soc.*, 1938, **57**, 245–55, 2 pls.). Cannibalistic feeding can be induced in *Blepharisma undulans* by feeding bacteria-fed ciliates with a diet of a small ciliate of another genus and then with a diet of small forms of its own kind. Cannibalism subsequently leads to the production of giant forms, which retain their dimensions after division if kept on the appropriate diet. Starvation causes the giants to divide at a higher rate, finally giving rise to individuals of normal size.

C. A. H.

Reversal of Ciliary Movement in Ciliates.—T. KAMADA ("Intracellular Calcium and Ciliary Reversal in *Paramecium*," *Proc. Imp. Acad.*, Tokyo, 1938, **14**, 260–2). If the ciliate *Paramecium* is immersed in a medium in which the ratio Ca/K is low, the direction of the ciliary beat can be reversed. It is held that this phenomenon is due to the external pellicle of the ciliate being more permeable to cations than to anions, as the result of which there occurs an exchange of intracellular Ca with the external K ions, the diminution of the Ca inside the body inducing the ciliary reversal. This view was tested by a series of micro-injections of the following substances into the ciliate: distilled water, sea water, M/2 NaCl, M/2 KCl, M/3 CaCl₂, M/60 Na-citrate, and M/40 Na-oxalate. An immediate reversal of the ciliary beat took place in response to the introduction of both Na-compounds. The effect of the injection of Na-alizarin-sulfonate is also discussed.

C. A. H.

New Record for Seabrookia.—PEDRO J. BERMÚDEZ ("Nueva especie de *Seabrookia* del Cretacico superior cubano," *Mem. Soc. Cub. Hist. Nat.*, 1938, **12**, No. 3, 163–5, text-figs. 1–3). The genus *Seabrookia* was until 1936 known only from a few records of the genotype *S. pellucida* Brady in the Indo-Pacific region and of *S. earlandi* J. Wright mainly in the Atlantic. In 1936 Palmer and Bermúdez extended its range by the discovery of *S. earlandi* in the Miocene of Cuba and of a new species *S. cubana* in the Oligocene of the same island. A further geological extension is indicated by the description of *S. cretacea* from the Upper Cretaceous (Maestrichian) of the province of Santa Clara, Cuba, where it occurs in a fauna rich in the genera *Globotruncana*, *Globorotalia*, *Gümbelina* and similar typical Cretaceous forms. The new species has distinct characteristics; resembling *S. pellucida* in general outline, it differs from that species in the absence of a marginal keel, the greater development of the oral opening which is large and furnished with a recurved lip, and in its bilateral symmetry. Viewed from the oral end, the two sides of the test are equally turgid.

A. E.

A New Cretaceous Bulimina.—PEDRO J. BERMÚDEZ ("Nueva especie de *Bulimina* del Cretacico superior cubano," *Mem. Soc. Cub. Hist. Nat.*, 1938, **12**, No. 2, 89–90, text-figs. 1–3). *Bulimina madrugensis* is abundant in the type locality Madruga, province of Habana, Cuba, and may be regarded as a "marker" species for the highest horizon of the Upper Cretaceous beds of the island. It occurs in company with abundant Foraminifera typical of that formation and has distinctive features. It is small, 0.25 mm. in length, triangular in section, with rounded edges slightly twisted, 5–6 whorls of distinct subglobose chambers separated by deep sutures. The torsion of the chambers about the long axis of the shell is an unmistakable and unique feature.

A. E.

Australian and New Zealand Operculinæ.—F. CHAPMAN and W. J. PARR ("Australian and New Zealand Species of the Foraminiferal Genera *Operculina* and *Operculinella*," *Proc. Roy. Soc. Victoria*, 1938, **50**, Pt. 1 (N.S.), 279–99, pls. 16–17, text-fig. 1). A study of the fossil and recent species occurring in Australia

and New Zealand. The authors list all the species which have been recorded from the Indo-Pacific region, and after a consideration of them and a particular study of the genotype *Operculina complanata* (Defrance) have decided to recognize only three species in the recent condition in the Australian-New Zealand area. These are *O. ammonoides* (Gronovius), *O. bartschi* Cushman, and *Operculinella venosa* (Fichtel and Moll). From the Miocene they record three new species: *O. victoriensis*, akin to *O. bartschi* Cushman, and common in the Miocene of Victoria; *O. kawakawaensis*, which bears some resemblance to *O. complanata* (Defrance) and occurs in the Lower Miocene of New Zealand; and *O. matapauensis*, a distinctive form from the Miocene of New Guinea. From the Eocene they recognize *O. pyramidum* (Ehrenberg) and *O. canalifera* d'Archæ. Full records of measurements, etc., of the species are given. In dealing with *O. ammonoides* (Gronovius) it seems regrettable that the authors do not refer to the little species from cold waters which has been so long and widely referred to *O. ammonoides*, but which has recently been separated from the tropical records and is now known as *Anomalina balthica* (Schroeter).
A. E.

Bibliography.—HANS E. THALMANN ("Bibliography and Index to New Genera, Species, and Varieties of Foraminifera for the Year 1935," *Jour. Paleont.*, 1938, 12, No. 2, 177-208). Dr. Thalmann continues his invaluable Index, the present instalment containing 427 titles of publications devoted to Foraminifera, of which 353 were issued in 1935, the balance being supplementary to the Lists for 1931-4. The tide is still rising, for these numbers show an increase over previous years. The present index lists an increase of three new sub-families, twenty-one new genera, five new sub-genera, 237 new species, and forty-two new varieties. The supplementary indexes for 1931-4 increase this formidable total to the extent of two new super-families, five new families, four new sub-families, one new genus, six new species, and one new variety. The author uses the term "generotype" for "genotype" or "genoholotype" in order to avoid confusion with the equivocal homonym used in genetics and heredity. Only eight homonyms are noted among the species created in 1935, but there is a long list of homonyms for 1931-4 supplementary to the lists already printed in the author's indexes for those years. This question of homonyms becomes one of increasing difficulty, for the output of species is so rapid that one can never be safe in renaming a species. The new name is quite likely to figure again as a homonym in the next index. This abstractor may perhaps quote one such example from his own lapses: *Textularia tenuissima* Earland, 1933, was a new name for *Textularia elegans* Lacroix, 1932 (not *Plecanium* (*Textularia*) *elegans* Hantken, 1868). But the eagle eye of Dr. Thalmann has observed that the specific name *tenuissima* is preoccupied by *T. tenuissima* Haeussler, 1881, *Univ. Zurich Diss.*, p. 40, figured, a paper which does not even appear in the Bibliographies of Sherborn, D'Arcy Thompson, or Brady. Such an experience is sufficient to explain both the reluctance of many authors to rename their homonyms, and the increasing use of such uncouth specific names as may be found in this index—*tombigbeensis*, *chickasawhayica*, *kingorum*, *mornhinvegi*, etc. All the simple names appear to have been appropriated!
A. E.

Miscellanea.—HANS E. THALMANN ("Mitteilungen über Foraminiferen. III," *Eclog. geol. Helvet.*, 1937, 30, No. 2, 337-56, pls. 21-3). Separate short communications on various subjects. (9) *Pleurostomella schuberti* Cushman and Harris, 1927, is a synonym of *P. bolivinoides* Schubert, 1911. (10) The genus *Staffia* Schubert, 1911 (generotype *Nodosaria tetragona* Costa, 1855), is a valid genus of the Family Heterohelicidae Cushman, sub-family Bolivitinæ Cushman, and not a

synonym of the genus *Amphimorphina* Neugeboren as stated by Cushman, or a synonym of *Mucronina* d'Orbigny as stated by Galloway. (11) Further identifications of the species figured in Brady's Challenger Report, according to modern nomenclature. A supplement to Dr. Thalmann's earlier publications on the subject of 1932-3. (12) Arguments for the retention of the generic names *Nummulites* Lamarck, 1801, and *Cristelleria* Lamarck, 1812. (13) Note on the systematics of the genus *Uvigerina* d'Orbigny, 1826. Within the last few years *Uvigerina* has been divided into various new genera: *Eouvigerina* Cushman, 1926; *Uvigerinella* Cushman 1926; *Pseudouvigerina* Cushman, 1927; *Angulogerina* Cushman, 1927; *Hopkinsina* Howe and Wallace, 1933. These are at most sub-genera of *Uvigerina*. (14) Remarks on the genera *Vaginulinopsis* Silvestri, 1904, *Marginulinopsis* Silvestri, 1904, and *Hemicristellaria* Stache, 1864. Three new species of *Marginulinopsis* and seven of *Vaginulinopsis* are figured and there are lists of already described species of *Cristellaria*, *Marginulina*, *Vaginulina*, etc., which in the author's opinion should be redistributed between *Marginulinopsis* and *Vaginulinopsis*. A. E.

Studies of Living Foraminifera.—J. LE CALVEZ ("Recherches sur les Foraminifères. I. Développement et reproduction," *Arch. Zool. Expér. et Générale*, 1938, 80, 163-333, pls. 2-7, text-figs. 1-26, graphs, etc.). This was a thesis for the author's degree of Doctor of the Faculty of Science at the University of Paris, and summarizes his work at the Marine Stations of Villefranche sur Mer and Banyuls sur Mer. It is many years since such an elaborate exposition of life-histories has been published. It is divided into a "Partie spéciale," dealing with the life-histories of three species, *Iridia lucida*, *Planorbulina mediterraneensis*, and *Patellina corrugata*, and a "Partie générale" in which the author gives his views on ectoplasm and endoplasm, nuclei, nuclear division, the general processes of reproduction and their cycle and with trimorphism.

It is not possible to deal with such a paper in a short abstract. The author sets forth his results and his convictions in a forcible manner, and some of the latter are likely to be controversial. He considers that Hofker's theory of "trimorphism" has been pushed too far, and that trimorphism is really confined to certain species only. And as regards Lister's theory of megalospheric (A) and microspheric (B) forms, he considers that it is restricted to those higher species in which sexual reproduction gives origin to flagellate gametes. In other species the two forms cannot be distinguished one from another.

The thesis is admirably illustrated.

A. E.

American Cretaceous Foraminifera.—J. A. CUSHMAN ("Additional New Species of American Cretaceous Foraminifera," *Cont. Cushman Lab. For. Res.*, 1938, No. 195, 31-50, pls. 5-8). Descriptions and figures of new species and varieties published in anticipation of a general report on the Cretaceous of the Gulf Coastal Plain of the United States. Thirty-five new species and three new varieties are described and figured. The plates from drawings and retouched photographs are admirable.

A. E.

A New Orbitoidal Genus.—T. WAYLAND VAUGHAN and W. STORRS COLE ("Triplalepidina veracruziana, a New Genus and Species of Orbitoidal Foraminifera from the Eocene of Mexico," *Journ. Paleont.*, 1938, 12, No. 2, 167-9, pl. 27). *Triplalepidina* occurs in the Upper Eocene Tantoyuca formation near Palma Sola, Vera Cruz, Mexico. The new genus is very similar to *Lepidocyclina* Gümbel except that the equatorial layer is divided into three zones near the periphery of the test. Two layers of small equatorial chamberlets are separated by a wedge-shaped layer

of clear shell matter. In various species of *Lepidocyclus* and its subgenera, the equatorial layer is commonly separated into chamberlets near the periphery, but these chamberlets are never separated by a distinct wedge of shell matter.

A. E.

Correction of Name.—R. WRIGHT BARKER ("On *Camerina petri* M. G. Rutten and *Nummulites striatoreticulatus* L. Rutten," *Geol. Mag.*, 1938, **75**, 49–51, pl. 3). *Camerina petri*, described in 1935 from Cuba by M. G. Rutten, is shown to be identical with *Nummulites striatoreticulatus*, described by L. Rutten from the Upper Eocene of Curaçao in 1928. Moreover, the specific name *petri* was pre-occupied by *Nummulites petri* Mancini, 1928. The species must be known in future as *Camerina striatoreticulata* (L. Rutten), and may prove a valuable guide to the Caribbean Upper Eocene, as it occurs in Curaçao, Jamaica, and Cuba.

A. E.

Relationships in the Foraminifera.—C. D. OVEY ("Difficulties in Establishing Relationships in the Foraminifera," *Proc. Geol. Assn.*, 1938, **49**, 160–70, pls. 8–9, text-figs. 29–32). An attempt to assemble some of the difficulties in establishing a systematic scheme for the Foraminifera. The author prefers the scheme of Chapman and Parr (1936) to those of Cushman (1933) or Galloway (1933). He has observed that specimens of a single species from one sample of material, either recent or fossil, sometimes vary not merely outside the specific but beyond even the generic limits, and would like to apply the "genomorph" term used by Smith and Lang (1930) for similar variations in Carboniferous corals, to identical cases in Foraminifera. Such a case he has observed in Kimmeridge Clay from Ely, where *Cristellaria laevigata* d'Orb passes through an intermediate species into the genus *Marginulina*. Such individuals should be known by the genomorphic term *Cristellaria (Marginulina) laevigata* d'Orbigny.

A. E.

Holocene Foraminifera.—W. A. MACFADYEN (Included in paper "On a Marine Holocene Fauna in North-Western Scotland," by D. F. W. Baden-Powell, *Jour. Anim. Ecol.*, 1937, **6**, No. 2, 274–6). Forty-three species of Foraminifera were extracted from a shelly clay at Udalain, near where a stream flows into Loch Alsh, a shallow-water assemblage of recent forms, practically all of which have been recorded as living in the same area. They do not show any difference from present climatic conditions, the boreal species *Elphidium arcticum* being absent. As regards salinity the list suggests normal marine conditions, *Elphidium crispum*, which is not tolerant of brackish water, being abundant, while the usual brackish-water indicator species are either absent or very rare.

A. E.

Viruses.

Equine Contagious Pneumonia.—J. M'FADYEN ("Equine Contagious Pneumonia, German Brustseuche," *J. comp. Path.*, 1938, **51**, 108–18, 7 figs.). This disease is caused by the combination of a virus and a streptococcus. To obtain the virus experimental animals, foals or colts, must be killed about the third or fourth day of the disease, as with the onset of the pneumonia the virus disappears. Post mortem there is pneumonia and pleurisy.

G. M. F.

Spontaneous Agranulocytosis.—J. S. LAWRENCE and J. T. SYVERTON ("Spontaneous Agranulocytosis in the Cat," *Proc. Soc. exp. Biol. N.Y.*, 1938, **38**, 914). Spontaneous agranulocytosis could be transmitted to other cats by subcutaneous or intrapentoneal injection of material derived from the liver of infected cats. Thirteen passages have been made and the causal agent is filterable.

G. M. F.

Nucleic Acid and Viruses.—C. F. ROBINOW and J. O. W. BLAND ("Application of the Feulgen Method to the Study of Viruses," *Nature*, 1938, **142**, 720), Nucleoid bodies giving a positive Feulgen reaction are integral constituents of various kinds of spore-bearing bacilli and also of *Bact. coli* and *Bact. paratyphosum*. Photographed in ultra-violet light these bodies showed the specific absorption characteristic of nucleic acid. In vaccinia the elementary bodies are negative and the small inclusions which characterize the early stages of infection positive for nucleic acid when stained by the Feulgen technique but the larger irregular type of inclusion is negative. In psittacosis both the large and small forms are positive, but in lymphogranuloma inguinale virus both large and small forms are negative.

G. M. F.

Trachoma.—F. H. STEWART ("Experimental Pathology of Trachoma," 12th *Ann. Rep. Memorial Ophthalmic Laboratory, Giza*, 1938, Appendix 1). The following forms of the virus are recognized: (a) *free forms*, (1) the free initial body of Lindner $0.5-1.0 \times 0.4\mu$; (2) elementary granules, $0.25-0.33\mu$, freed by rupture of Prowazek-Halberstaedter bodies; (b) *intracellular forms*, (1) initial bodies $0.5-1.0 \times 0.5\mu$, scattered or aggregated to form inclusions—the Prowazek-Halberstaedter bodies $3.0-13.0\mu$; (2) elementary granules in the centre of larger Prowazek-Halberstaedter bodies, $0.25-0.33\mu$. Inclusions begin as initial bodies and elementary granules appear in their centre only after they have reached some size. Prowazek-Halberstaedter bodies can be found in all cases of early trachoma. The virus of trachoma is slightly less in size than *Bacillus prodigiosus*. Elementary granules which pass membranes of $0.5-0.7\mu$ a.p.d. are not infective. There is no proof that accessory bacteria are essential to infection with trachoma. Trachoma is not carried by lice or flies.

G. M. F.

Rickettsia in Trachoma.—P. THYGESON ("Problem of Rickettsias in Trachoma," *Arch. Ophth.*, 1938, **20**, 16). Trachomatous materials from Tunis, Brazil, and the U.S.A. were examined for the rickettsia-like bodies described by Busacca, Cuénod, and Nataf. No minute parasitic bodies other than the elementary and initial bodies of the epithelial cell inclusions of trachoma could be demonstrated. The rickettsia-like bodies are regarded as being probably cell-granules or cytoplasmic débris.

G. M. F.

The Agent of Inclusion Conjunctivitis.—L. A. JULIANELLE, R. W. HARRISON, and A. C. LANGE ("Studies on the Infectious Agent of Inclusion Blepharitis," *Amer. J. Path.*, 1938, **14**, 579-94). Inclusion conjunctivitis is transmissible to apes and monkeys as a self-limited conjunctivitis without complications or sequelae: the infectious agent is incapable of serial transfer in monkeys and it stimulates no immunity in recovered animals. Transmissibility to monkeys is not dependent on the bacteria present in active tissues from infectious patients. The infectious agent while losing a certain degree of activity passes collodion membranes with an A.P.D. of *circa* 0.6μ . It was not possible to grow the infectious agent under several conditions of tissue culture. The relation of the virus and the inclusion body is still uncertain.

Oral Papillomatosis of Rabbits.—R. J. PARSONS and J. G. KIDD ("Oral Papillomatosis of Domestic Rabbits: a Virus-induced Disease," *Amer. J. Path.*, 1938, **14**, 634-5). Oral papillomatosis, usually appearing on the under surface of the tongue, was found in 9.6 p.c. of normal rabbits and in 42.8 p.c. in animals whose ears had been tarred. The filterable agent can be preserved in glycerol for a year

at least and it remains active when frozen and dried. Animals immune to the skin papilloma virus are susceptible to the oral papilloma virus. A few cells contain type A acidophilic intranuclear inclusion bodies. G. M. F.

Observations on a Neurotropic Virus.—R. BIELING ("Untersuchungen über ein neurotropes Virus," 17 *Tag. d. deutsch. Verein f. Mikrobiologie in Zbl. Bakt., Abt. I, Orig.* 1937, 150, 154). The virus of louping ill injected intraperitoneally into the mouse passes rapidly within an hour into the blood stream and is found in the liver, spleen, and cerebellum: then the titre of virus in these organs decrease up till about the 48th hour, when, coincident with the clinical symptoms, the titre again increases. In mice treated before infection with two injections of immune serum virus behaves as in normal animals and may be obtained from the cerebellum 16–57 days after inoculation. Trypan blue given intravenously does not normally pass into the brain of mice, but in mice infected with louping ill it does pass. It is suggested that the virus produces lesions in the capillaries and passes directly from the blood to the brain. G. M. F.

The Development Cycle of Some Rickettsia.—A. DONATIEN and F. LESTOQUARD ("Du cycle évolutif de quelques Rickettsia," *Bull. Soc. Path. exot.*, 1938, 31, 593–9, 3 text-figs.). Development cycles are described for *Rickettsia conjunctivæ*, *R. canis*, *R. ovina*, *R. bovis*, *R. ruminantium*, and *R. conori*. Large masses "initial bodies," give rise to elementary bodies in all the organisms studied. G. M. F.

The Virus of Lymphogranuloma Inguinale.—G. M. FINDLAY, R. D. MACKENZIE, and F. O. MACCALLUM ("A Morphological Study of the Virus of Lymphogranuloma Inguinale (Climatic Bubo)," *Trans. R. Soc. trop. Med. and Hyg.*, 1938, 32, 183–8, 2 pl., in colour). Large and small forms of the virus of lymphogranuloma inguinale are described and figured. Evidence is brought forward to show that the two forms may be differentiated by Castaneda's stain. G. M. F.

Specific Inclusions in the Chorio-allantoic Membrane of the Chick Embryo infected with Vaccinia.—W. GROSS ("Ueber die spezifischen Zelleinschlüsse der Chorio-Allantois beim Huhn nach Vakzineinfektion," *Z. Immunitätsf.*, 1937, 91, 1). Lesions on the chorio-allantoic membrane of the developing chick-embryo infected with vaccinia were stained with Victoria blue. Inclusions composed of elementary bodies and a product of cellular secretion were found. They closely resembled the Guarneri bodies of the rabbit's cornea. G. M. F.

BOTANY.

(Under the direction of J. RAMSBOTTOM, O.B.E., D.Sc.)

Cytology.

Chromosome Complements in the Cactaceæ.—E. C. BEARD ("Some Chromosome Complements in the Cactaceæ and a Study of Meiosis in *Echinocereus papillosus*," *Bot. Gaz.*, 1937, **99**, 1-21). Chromosome numbers are given for forty-six species of the tribe Cereæe. The basic number is 11, and is the haploid number for the majority of species. *Mediocactus coccineus*, *Neomammillaria compressa*, and *N. multiceps* are tetraploids whose origin is discussed. One aneuploid *Echinocereus blanckii* is described. The meiotic behaviour of *E. papillosus* was found quite normal. The relation of the chromosome numbers to taxonomy is discussed. Cytological and morphological evidence favours the view that the tribe Cereæe is still relatively young. J. S.

Cytology of Rice.—H. K. NANDI ("Cytological Investigations of Rice Varieties," *Cytologia*, 1937, **8**, 277-305). The chromosome number in seven varieties of Rice is 12 haploid, 24 diploid. During heterotypic prophase the nucleoli remain closely connected with a particular pair of chromosomes from the leptotene stage until the nucleolus disappears at metaphase. The end of the attached chromosome is referred to as the nucleolar body. It is concluded that the nucleolus contributes matrix substances indirectly to all the chromosomes and a nucleolus is formed at telophase from this substance under the influence of the nucleolar body present at the end of one chromosome of the haploid complement. Irregularities of division, resulting in diploid gametes, are described. The origin of the nucleolus is discussed and its relation to the nucleolar body; also the possible role of the nucleolus in inheritance. J. S.

Chromosome Morphology in Spinacia.—A. LORZ ("Cytological Investigations on Five Chenopodiaceous Genera with Special Emphasis on Chromosome Morphology and Somatic Doubling in *Spinacia*," *Cytologia*, 1937, **8**, 241-76). Nine species and varieties of *Spinacia* were investigated. In each the somatic chromosome complement is made up of two large pairs with sub-median attachment constrictions, two medium-sized pairs with subterminal attachment constrictions, and two small pairs with subterminal constrictions. One of the small pairs has trabants on the shorter arm. A study of male, female, and intersexual plants failed to reveal any heteromorphic allosomes. Chromosome numbers of four species of the Chenopodiaceæ hitherto undetermined are: *Suaeda linearis* $2n = 54$, *Kochia scoparia* $2n = 18$, *Salsola Kali* var. *tragus* $2n = 36$, *Chenopodium ambrosioides* $2n = 32$. Somatic doubling was found in each species of *Spinacea* investigated and in *Kochia scoparia*. A new hypothesis, based on the conception that chromosomal division and nuclear division are not always interdependent, but may be influenced by environment to behave in an asynchronous manner, is put forward to explain somatic doubling. J. S.

Meiosis in *Saccharum*.—J. K. SANTOS ("Microsporogenesis of *Saccharum spontaneum* with Special Reference to its Chromosome Number," *Cytologia*, 1937, 8, 220-40). Meiosis in *Saccharum spontaneum* var. *indicum* is described in detail and illustrated by thirty-three text-figures. No irregularities are observed in the heterotypic division. The haploid number of chromosomes is 40. The daughter nuclei pass without a resting stage into normal homæotypic division, forming the four nuclei of the pollen grains. J. S.

Tetraploid Rice.—T. MORINAGA and E. FUKUSHIMA ("Cyto-genetical studies on *Oryza sativa* L. III. Spontaneous Autotetraploid Mutants in *Oryza sativa* L.," *Jap. Jour. Bot.*, 1937, 9, 71-94). One autotetraploid plant of *O. sativa* L. was found in 1933 in the F_4 progeny of a sterile intraspecific hybrid. Since that, other tetraploids have been found in the offspring of highly sterile plants. The tetraploids are morphologically distinguishable, being of typical *gigas* type with short panicle stalks and remarkably developed awns. Their fertility varies from 5 to 35 p.c. The origin of the tetraploids is regarded as due to somatic chromosome doubling in the pro-embryo or in later meristematic tissues. Chromosome behaviour is essentially the same in micro- and megasporogenesis. The four homologous chromosomes form a tetravalent or two bivalents. The components of the tetravalent are usually evenly distributed to the poles and regular nuclear and cell division follows. Nearly half the microspores thus formed are non-viable, and in about 40 p.c. of the ovaries no megaspores show further development. J. S.

Development of the Blepharoplast and Fertilization in Some Ferns.—A. YUASA ("Studies in the Cytology of Pteridophyta. XIV. Spermatoteleosis and Fertilization in Some Ferns, with Special Reference to Border-brim," *Jap. Jour. Bot.*, 1937, 9, 16-35). In the spermatoteleosis of ferns the blepharoplast appears as a small spherical body in the spermatid, and during development differentiates into border-brim, cilia-bearing band and lateral bar. In fertilization the border-brim and lateral bar (and sometimes the cilia-bearing band) enter the egg-nucleus and fuse with it. The cytoplasm, plastids, and chondriosomes of the spermatozoid are cast away before fertilization; the newly formed embryo then inherits the cytoplasm, plastids, and chondriosomes of the egg-cell only. The blepharoplast is considered to be of nuclear origin, and to be formed from that part of the nucleoplasm which is distinct from the chromatin-substance. J. S.

Chromosome Numbers in *Crocus*.—K. KARASAWA ("Karyological Studies in *Crocus*. I," *Jap. Jour. Bot.*, 9, 1937, 1-15). Chromosome counts were made in twelve species and one variety of *Crocus*. The following haploid numbers were found, 3, 4, 5, 6, 9, 11, and 13. The chromosome formula of *C. sativus* var. *Elaverii* is given as $2n - 1$ ($n = 8$). *C. verricolor picturatus* was triploid with 39 somatic chromosomes. Non-disjunction and lagging were observed in sporogenesis in all the species studied. Tetraploid cells were found in the root-tips of *C. speciosus* and *C. Sieberi*. In some species the mature pollen was more or less deformed but the fertility was normal. J. S.

Anatomy and Morphology.

The Proportions of Fibres, Vessels, and Parenchyma in Various Woods.

—B. HUBER and G. PRÜTZ ("Über den Anteil von Fasern, Gefässen und Parenchym am Aufbau verschiedener Hölzer," *Holz als Roh- und Werkstoff*, 1938, 1, 377-81, 8 figs.). From microscopic observations on sections, figures are given for the percentage of fibres, vessels, rays, and parenchyma in thirty-five species. Coniferous woods consist of over 90 p.c. fibres (tracheids) and less than 10 p.c. rays. In the wood

of broad-leaved trees the proportion of fibre varies between 75 p.c. and 28 p.c.; rays and parenchyma together occupy from 10 p.c. to 63 p.c. In many tropical woods the proportion of vessels is less than 10 p.c.; in Central European species it is generally between 15 p.c. and 30 p.c., and may be as much as 50 p.c. in root wood.

B. J. R.

Standard Terms for Vessel Diameter and Ray Width.—L. CHALK ("Standardization of Terms for Vessel Diameter and Ray Width," *Trop. Woods*, 1938, **55**, 16–23, 1 fig.). In order to provide a sound theoretical basis for proposing a series of size classes for wood vessels and rays, measurements were made on 150 species and their mathematical distribution worked out. Seven classes and terms for maximum vessel diameter are proposed and a similar number for maximum ray width. The numerical values of these classes correspond very closely with those proposed by Chattaway in 1932 and only one minor alteration is suggested.

B. J. R.

Compression Failures in Timber.—H. E. DADSWELL and I. LANGLANDS ("Brittle-Heart and its Relation to Compression Failures," *Emp. For. J.*, 1938, **17**, 58–65, 2 pls.). Abnormally brittle heartwood in numerous species of Australian timbers, particularly eucalyptus, is associated with broken fibres due to minute compression failures. Gross compression failures, on the other hand, sometimes occur outside the limits of brittle heartwood, which suggests that gross and minute compression failures may be due to different causes.

B. J. R.

Anatomy of Brazilian Woods.—F. R. MILANEZ (*Arch. Inst. Biol. Veget.* Rio de Janeiro, 1937, **3**, 211–5, 2 pls.; 1938, **4**, 65–70, 3 pls., 1 fig.; 1938, **4**, 79–85, 2 pls.). In the first paper the wood anatomy of *Ampelocera glabra* Kuhlmann is described and illustrated. The second is concerned similarly with *Aspidosperma aquaticum* Ducke. The third deals with the distinction between different types of crystalliferous strands of wood parenchyma.

B. J. R.

Wood Structure of Australian Cunoniaceæ.—H. E. DADSWELL and A. M. ECKERSLEY ("The Wood Structure of Some Australian Cunoniaceæ with Methods for their Identification," *Council for Sci. and Ind. Res., Bull.* 119, Melbourne, 1938, 1–23, 7 pls.). The results of the examination of the wood structure of eleven species of Australian Cunoniaceæ are described. The description of each species covers the habit and distribution of the tree, the general properties of the timber, and the details of wood anatomy. These descriptions are illustrated by photomicrographs of the wood structure. There is a key to the identification of the timbers. On the basis of anatomical features the family has been divided into two groups, namely: (i) including *Ackama*, *Anodopetalum*, *Callicoma*, *Ceratopetalum*, *Cunonia*, *Pancheria*, *Platylophus*, *Spiræopsis*, and *Weinmannia*; and (ii) including *Geissois* and *Schizomeria*. The Australian species *Weinmannia lachnocarpa* F. v. M. has been included with the genus *Geissois*, and it has been suggested that on anatomical grounds it is better classified as *Geissois lachnocarpa* J. H. M.

B. J. R.

The Twin-hairs of Compositæ.—R. HESS ("Vergleichende Untersuchungen über die Zwillingshaare der Compositen," *Bot. Jahrb.*, 1938, **68**, 435–96, 72 figs.). The considerable literature on the characteristic twin-hairs found in such diverse forms on the achenes of many of the Compositæ is reviewed. The parts of a typical twin-hair are described and are given precise terms; a diagram is provided. The development of these hairs follows two distinct paths, resulting in two types of mature hair. In the typical twin-hair (seen in the majority of the Tubifloræ) the initial cell enlarges and divides at right angles to the surface of the epidermis. The two cells

thus formed each divide into an upper hair-cell and a basal cell. The basal cell nearest the apex of the achene is longer than the lower and projects above the epidermis of the achene. In the second type of development (seen in some of the Mutisæ) the division of the two cells is symmetrical, resulting in two equal basal cells, neither projecting above the epidermis. The general morphology of the twin-cells is described and a hypothetical primitive type arrived at. The primitive type is thought to be very similar to that found in *Ageratum*, *Eupatorium*, and *Arnica*. Investigation shows that in the sub-family Tubifloræ almost each species has its own form of hair, though they are easily derived from the primitive type. Special modifications are due to enlarged basal cells; it is the uppermost basal cell which is most usually enlarged, and it is thought to be hygroscopic. The cavity of the hair-cells may be greatly reduced by thickening of the walls, and their apices show divers forms. Twin-hairs are particularly frequent in the Tribes Asteræ, Inulæ, Heleniæ, and Senecionæ. They are present also in numerous species of Veroniceæ, Eupatorieæ, Heliantheæ, Arctotideæ, and Mutisieæ. In the Cynareæ only the Carliniæ except for two species of Carduinaæ are known to have twin-hairs. In the tribe Anthemideæ and Cichorieæ twin-hairs are found only in a few systematically isolated genera. The capacity to produce twin-hairs on the pericarp is therefore found in more or less of the species of all the tribes of the Compositæ, and it may be regarded as a characteristic of the family. W. R. P.

Floral Morphology.—J. H. SCHAFFNER ("The Fundamental Nature of the Flower," *Bull. Torr. Bot. Club*, 1937, 64, 569–82, 11 figs.). The author holds the view that the primary factor in the evolution of the Angiospermous flower is the determinateness of the floral axis. If the reproductive axis of a vascular sporophyte is indeterminate then the plant is a flowerless plant. In primitive flowers determination is less definite, stoppage of growth taking place gradually resulting in a large and variable number of sporophylls. In more advanced types determination is very definite. This degree of determination, together with the variable lateral and longitudinal growth of the axis, has resulted in the different flower types. The author stresses the relationships of the sexual organs rather than of the perianth in the definition of his floral types. The nine floral types which he recognizes are each described. In addition, the general tendencies of floral evolution are outlined. W. R. P.

Histology of Parthenogenetic Fruits.—F. E. GARDNER and E. J. KRAUS ("Histological Comparison of Fruits developing Parthenogenetically and following Pollination," *Bot. Gaz.*, 1937, 99, 355–76, 17 figs.). Spraying holly flowers with growth-promoting solutions produced a crop of berries indistinguishable from pollinated fruits, except that they are devoid of embryos. Pistils sprayed with indoleacetic acid, pollinated, and untreated, were preserved and their histological structures compared. Without pollination or treatment no further development occurs and after some disintegration abscission takes place. After fertilization in the pollinated fruits endosperm development takes place. The embryo is slow in developing. The epidermal cells of the integument become much enlarged and their walls suberized. The cells of the vascular bundles enlarge and mature as the fruits develop. This is particularly so in the endocarpic region; there is little increase below the carpels or in the peduncles. The development of sprayed fruits is closely parallel to that of normal fruits. The chief differences are as follows. The cells of the stigma proliferate more and do not collapse and suberize so soon. The embryo does not develop, its place being taken by a cavity, which is not, however, of equal size with the normal embryo. The cells of the integument enlarge

and suberize as in the normal fruit. The endocarp enlarges and hardens at about the same rate as in the normal fruit, as do the vascular bundles, so that no external differences are apparent. It is particularly interesting that no abnormal growths or tumours are produced, as is the case when growth substances are applied to the stems of several plants.

W. R. P.

Embryo Sac of *Limnocharis*.—B. M. JOHRI ("The Embryo Sac of *Limnocharis emarginata* L.," *New Phyt.*, 1938, **37**, 279–85, 16 figs.). A reinvestigation of the embryo sac of *Limnocharis emarginata* was undertaken and showed that the previous accounts were erroneous in some essential respects. Previous authors had stated severally that the sac was either tetrasporic and five-nucleate or monosporic and six- to eight-nucleate. The present observations show that a tetrad of megaspores is not formed and that the embryo sac is bisporic, arising from the lower cell of the diad formed after the first (meiotic) division of the megaspore-mother-cell. This nucleus divides to produce the primary chalazal and the primary micropylar nuclei. The former usually degenerates and is cut off by a membrane. The primary micropylar nucleus divides twice and produces the egg-apparatus and the upper polar nucleus. The mature embryo sac is, therefore, five-nucleate, but occasionally the primary chalazal nucleus may fragment, resulting in a six-, seven-, or even an eight-nucleate embryo sac.

W. R. P.

Development of Floral Organs of *Helosis*.—F. FAGERLIND ("Bau und Entwicklung der Floralen Organe von *Helosis cayennensis*," *Svensk. Bot. Tidsk.*, 1938, **32**, 139–59, 24 figs.). An account is given of the regular distribution of the female and male flowers on the spadix of *Helosis cayennensis* (Swartz) Spreng. The anthers are attached at the back of the loculi; they are superposed above the perianth leaves. The anther cells were empty, but pollen was found on the stigmas of the female flowers. Meiosis was seen in the embryo sac mother-cell. The mature embryo sac is eight-nucleate; its development is according to the scheme of *Scilla*. The author is able to show that *Helosis* is not apomictic.

W. R. P.

Embryogeny of *Zizania*.—C. D. LA RUE and S. AVERY, Jr. ("The Development of the Embryo of *Zizania aquatica* in the Seed and in Artificial Culture," *Bull. Torr. Bot. Club*, 1938, **65**, 11–21, 8 figs.). The embryo of *Zizania aquatica* L. is particularly suited to experiments in which normally and artificially developed embryos are to be compared, as the marked elongation of the cotyledon and epiblast provides a stage at which comparison is easy. Embryos of different ages were dissected from their ovaries and representative specimens of each stage were fixed and sectioned. A corresponding set of embryos was placed on nutrient agar in Petri dishes and after five days' culture this second set was sectioned for comparison with the normal embryos. Growth in culture is generally characterized by precocious development of the shoot and retarded growth of the primary root. In older embryos elongation of the primary root is not appreciably retarded. Growth of the cotyledon and epiblast is arrested upon transference to agar. Normal growth and development of the embryo was found to be dependent upon its presence within the tissues of the parent plant.

W. R. P.

Ovule of Ranunculaceæ and Berberidaceæ.—M. KUMAZAWA ("On the Ovular Structure in the Ranunculaceæ and Berberidaceæ," *Journ. Jap. Bot.*, 1938, **15**, 10–25, 3 figs.). The structure of the carpel and the structure and position of the ovules in the Ranunculaceæ and Berberidaceæ are described. In the former family the suture of the pistil is ventral and the ovules are marginal; in the latter the pistil has no marked ventral suture and the ovules are scattered on the lamina

of the pistil. The two families are therefore quite distinct in this respect. Even in those Berberidaceous genera in which the placentation is basal at maturity, a stage is passed through when it is parietal, the upper part of the pistil subsequently elongating enormously. Most genera of the tribe Helleboreæ have the outer integument shorter than the inner, but *Aquilegia* alone in the tribe has the relative lengths of the integuments reversed. Among the genera examined an intraseminary bundle has been found in *Glaucidium* and *Anemone*. In the ovule of *Pæonia* and *Nandina* the nucellar tissue is absorbed and the epidermal layer of the integument is changed into a palisade layer before the flower opens. It is thought that these two genera have diverged from the line of evolution of the typical members of the two families.

W. R. P.

Fascicle of Lamarkia.—A. R. BEDOWS ("The Variability in, and Nature of the Spikelets comprising the Fascicle in *Lamarkia aurea* Moench.," *New Phyt.*, 1938, 37, 113–29, 4 figs.). The fascicle of *Lamarkia aurea* in the most common form is regarded as consisting of five spikelets which are classed as one principal-fertile, one reduced-fertile, and three sterile spikelets. The principal-fertile spikelet has two or three florets, the lowest of these being usually perfect and functional. The reduced-fertile spikelet has two florets of which the basal is not infrequently functional. Each of the three sterile spikelets contains from six to fifteen florets, all of which are imperfect and neuter. All spikelets may show quantitative and even qualitative variation. The number of each category of spikelet which occurs in a fascicle may also vary within certain limits. The nervation of the occasional functional and of the non-functional florets of the sterile spikelets is similar to that in comparable florets of fertile spikelets. The position and derivation of the awn are apparently the same for all the spikelets in the fascicle, and it is put forward that all the spikelets in the fascicles are homologous.

W. R. P.

Inflorescence of Juglandaceæ.—W. E. MANNING ("The Morphology of the Flowers of the Juglandaceæ. I. The Inflorescence," *Amer. J. Bot.*, 1938, 25, 407–19, 51 figs.). The inflorescences of all the six genera of the Juglandaceæ are described and figured, and a possible evolutionary series proposed. The probable ancestral inflorescence is described as a terminal highly branched panicle of perfect flowers. In the modern genera the inflorescence of primitive types is a terminal androgynous panicle, with one central pistillate and several lateral staminate branches or catkins. From this there is an advance to inflorescences which are entirely pistillate or entirely staminate. In the former the solitary catkin remains terminal or very rarely axillary, while the staminate inflorescences advance from a terminal position to an axillary one, first in the axils of foliage leaves and later in the axils of bud scales. Advance is also from a several-catkin panicle to fewer and finally a single sessile catkin. *Engelhardtia*, *Alfaroa*, and *Platycarya* have primitive types and positions of inflorescence. *Pterocarya* has advanced types; while those of *Juglans* are still more so. *Carya* has staminate inflorescences of a primitive type, though with a specialized location; its pistillate catkin is the most advanced in the family.

W. R. P.

CRYPTOGAMIA.

Pteridophyta.

Regnellidium.—DUNCAN S. JOHNSON and M. A. CHRYSLER ("Structure and Development of *Regnellidium diphyllum*," *Amer. Journ. of Bot.*, 1938, 25, 141–55, 57 figs.). *Regnellidium*, a monotypic genus of Marsileaceæ, was discovered by

Lindman in south Brazil in 1892, and was not found again till 1935. It was described and figured by Lindman in *Arkiv. f. Bot.*, 1904. The late Prof. D. S. Johnson devoted some months to the study of its anatomy; his work is now completed by Mr. Chrysler. The internal structure of stem, leaf, and root corresponds closely with that of *Marsilea*, and the vascular tissues are very similar to those of many leptosporangiate ferns. The anatomy and development of the plant are described and figured in detail. In its general features and in structure *Regnellidium* is intermediate between *Marsilea* and *Pilularia*. No trace of more than two leaflets has been observed, and the sporocarp is always single. The vascular structure of the capsule strongly suggests that it represents a pair of pinnae. A. G.

Lycopodium and Aluminium.—J. BAHÍČKA ("Analysis of the Ashes of *Lycopodium clavatum* and *L. annotinum*, and Bibliography of Aluminium in Plants," *Mém. Soc. R. Lettres et Sci. de Bohême*, Ann. 1937, No. III, 1–18). A survey of the literature on the occurrence of aluminium in plants; and a special investigation of the ash residues of *Lycopodium*, where the quantity of alumina present proved to be considerable, being 27.45 p.c. in *L. clavatum* and 32.73 p.c. in *L. annotinum*. *Lycopodium* is unique in the plant world for its very high aluminium content. Also titanium, hitherto unsuspected, is present up to the amount 1.2 p.c. of TiO_2 ; and ferric oxide up to 10 p.c. A. G.

Dennstaedtia.—GUALTERIO LOOSER ("El helecho *Dennstaedtia glauca* (Cav.) C. Chr. en la Argentina," *Lilloa*, 1937, 1, 249–51). *Dennstaedtia glauca* was first recorded from Chile by Cavanillers and later from Bolivia. It was shown by Christenson in 1937 to be identical with *D. Lambertieana*. It is now recorded from three localities in the Argentine provinces of Tucumán and La Rioja. Its fronds are four-pinnatifid to four-pinnate with the ultimate segments narrow. A. G.

Adiantum.—MOTOZI TAGAWA ("The Genus *Adiantum* L. in Japan," *Journ. of Japanese Bot.*, 1938, 14, 307–17, 389–97). A synopsis of the Japanese species of *Adiantum*, preceded by a key. Fifteen species occur in the Japanese possessions, two of them being new to science. The synonymy, literature, and distribution of each species are set out. A. G.

Asplenium fontanum.—T. M. C. TAYLOR ("The Typification of *Asplenium fontanum* (L.) Bernh.," *Journ. of Bot.*, 1938, 76, 277–9). A discussion of the *Polypodium fontanum* of Linnæus. The specimens in the Linnæan herbarium are *Woodsia glabella*. The diagnosis in the *Species Plantarum*, ed. I, is of the latter plant; but the synonym leads to *Asplenium fontanum*; and the following note specifies the indusium of *Asplenium*. In the *Species Plantarum*, ed. II, the diagnosis was widened so as to cover both plants. The upshot of the discussion is that there appears to be justification for regarding *Asplenium fontanum* Bernh. as the proper interpretation of *Polypodium fontanum* L. A. G.

Asplenium monanthes.—GUALTERIO LOOSER ("El helecho *Asplenium monanthes* L. y su presencia en Chile," *Revista Sudamericana de Bot.*, 1938, 5, 75–7, 1 fig.). This fern has a distribution from Africa to tropical America and Hawaii. As it had seldom been recorded from Chile, the purpose of the present paper is to give an account of all the Chilean specimens of the fern that could be traced in herbaria, together with the synonymy of the species. A. G.

Meniscium.—WILLIAM R. MAXON and C. V. MORTON ("The American Species of *Dryopteris*, Subgenus *Meniscium*," *Bull. Torrey Bot. Club*, 1938, 65, 347–76, 4 pls.). An account of the old genus *Meniscium* of Schreber (1791) and of its

affinities; and how it was elaborated by Fée (1852). All available material has now been revised by the authors, who have drawn up a monograph of *Meniscium* as a subgenus of *Dryopteris*, comprising twenty-one species, with descriptions (where necessary), critical notes, synonymy, and distribution. There is a key to the species. Four new species are described; and a few name changes had to be made.

A. G.

Oleandra.—YUDZURU OGURA ("Anatomy and Morphology of *Oleandra Wallichii* (Hook.) Pr., with Some Notes on the Affinities of the Genus *Oleandra*," *Japanese Journ. of Botany*, 1938, 9, 193–211, 9 figs.). An account of the anatomy and morphology of *Oleandra Wallichii* from Formosa and of five other species. Three species, *O. Wallichii*, *O. Cumingii*, and *O. Whitmeei*, have a creeping rhizome with dorsal leaves and ventral roots, while *O. nereiformis*, *O. pistillaris*, and *O. benguetensis* have an erect stem producing leaves and roots on all sides. The stem is covered with peltate scales. The vascular system is a cylindric dictyostele consisting of large laxly anastomosing meristeles from which smaller branches are given off, and pass into the fronds as leaf traces. The stele of the articulated petiole and midrib is of a *Polypodium* type, with two large adaxial and one or two small abaxial meristeles. The lateral veins of the lamina are straight or forked and run parallel. The sorus is solitary and situated near the base of the vein and is covered with a reniform indusium. The sporangia, situated on a receptacle, are of a mixed type; each is provided with a few paraphyses and is Polypodiacean in structure. The spores are reniform. The root-like organ, which arises exogenously from the stem, is provided with multicellular hairs but no root-cap, and produces branches endogenously which are provided with unicellular hairs and root-caps; both have a diarch bundle: thus it is a case of a rhizophore producing true roots. To sum up, the genus *Oleandra* is far removed from other ferns and deserves to be placed in a special tribe or family.

A. G.

Galapagos Ferns.—H. K. SVENSON ("Pteridophyta of the Galapagos and Cocos Islands," *Bull. Torrey Bot. Club*, 1938, 65, 303–33, 3 pls.). A list of seventy-four ferns and nine fern allies from the Galapagos Islands, founded on the collections made by the Astor Expedition in 1930, by Charles Darwin on the voyage of the Beagle (1831), by Thomas Edmondston of the *Herald* (1845), A. Stewart (1911), and others. Fourteen of these ferns are suspected to have been collected not in the Galapagos Islands but on the South American mainland, the labels having become mixed after Edmondston's tragic death (1846). Forty of the species are found also in the West Indies; and nineteen are found also in Madagascar. *Notholaena galapagensis* is a new species. The list of Cocos Island pteridophytes comprises twenty-four species, collected by the Astor Expedition.

A. G.

Ferns of East Asia.—MOTOZI TAGAWA ("Spicilegium pteridographiae Asiæ orientalis, 14," *Acta Phytotax. et Geobot.*, 1937, 6, 154–68). Descriptions of seven new ferns from Formosa and emended descriptions, critical notes, synonymy, and distribution of eight other Japanese species.

A. G.

Japanese Ferns.—MOTOZI TAGAWA ("Miscellaneous Notes on the East-Asiatic Pteridophytes with Special Reference to the Japanese Species. V," *Journ. of Japanese Bot.*, 1938, 14, 101–12). Taxonomic notes on thirteen Japanese ferns, including descriptions of six new species.

A. G.

Bryophyta.

Lophocolea minor.—G. CHALAND ("De *Lophocolea heterophylla* l(Schr.) Dum. à *Lophocolea minor* Nees. Un cas de régression de l'appareil sexué," *Bull. Soc. Bot. de France*, 1937, **84**, 258–69). An extensive comparison of specimens of *Lophocolea heterophylla* and *L. minor* with numerous herbarium specimens has shown that *L. minor* is only an asexual form of *L. heterophylla*, connected with the type by a series of intermediates (as shown in a series of figures drawn from nature). There is evidence of the gradual disappearance of the sexual apparatus. First the antheridia and the antheridial pockets in the bracts are lost, then the perianth and perichætal bracts; and this regression is often accompanied by a diminution of plant size and by the appearance of various modes of vegetative multiplication, such as adventive branchlets and abundant propagula. Already, thirty years ago, Ch. Douin had indicated the relationship of the plants and had styled the second species *L. heterophylla* var. *minor* Douin. A. G.

Bryoxiphium.—WILLIAM CAMPBELL STEERE (" *Bryoxiphium norvegicum*, the Sword Moss, as a Preglacial and Interglacial Relic," *Ecology*, 1937, **18**, 346–58). The history and distribution of this moss are remarkable. The origin of the type specimen is unknown. Though named *norvegicum*, no trace of the moss can be found in Scandinavia nor on the mainland of Europe; but a century ago it was found in Iceland (which was probably the source of the type), and in 1932 in Greenland, while in the United States it was discovered by Sullivant in Ohio (1845) and is now known from eight other States. But Mr. Steere shows that the American localities are all unglaciated areas and claims that this moss is a relic of a preglacial flora. In Japan and Korea occurs a very closely allied species, *B. Savatieri*; also *B. mexicanum* is a distinct species. The genus has no near affinities, which is another reason for regarding it as a relic of the past. A. G.

Mosses on Trees.—N. MARY MARTIN ("Some Observations on the Epiphytic Moss Flora of Trees in Argyll," *Journ. of Ecology*, 1938, **26**, 82–95, 1 fig.). An investigation of the mosses found on various species of trees in a cool climate with heavy rainfall. On sheltered trees mosses and lichens are abundant on trunk, branches, and branchlets, and show a marked zonation. On windswept trees the moss covering is scantier, less zoned, and nearer to the ground. On sheltered trees the lowest zone consists of caespitose species, the middle zones of *Eurhyncium myosuroides* and forms of *Hypnum cupressiforme*, while the top zone is of pioneer species such as *Ulota crispa* and *Pylaisia polyantha*. The moss covering of ash-trees is less dense than that of oaks; and it would seem that differences in the moss flora on different types of trees is chiefly due to greater or less roughness of the bark. A. G.

African Mosses.—H. N. DIXON ("Tropical East African Mosses.—Part I. Acrocarpi," *Journ. of Bot.*, 1938, **76**, 217–28; 249–61, 1 pl.). A series of determinations of nearly a hundred acrocarpous mosses from East Tropical Africa, including thirty-three new species and two varieties; others are of special interest or rarity, or mark an extension of distribution. They were gathered in recent years by various collectors in Uganda, Kenya, and Tanganyika. Besides the descriptions of the novelties a number of critical notes are given. A. G.

Alaskan Mosses.—EDWIN B. BARTRAM ("Mosses of the Aleutian Islands, Alaska," *Bot. Notiser*, 1938, 244–56, 1 fig.). A list of 129 mosses collected in the Aleutian Islands by Hultén and Eyerdam in 1932, with a description and figure of a new species, *Bryhnia Hultenii*, from Kodiak Island. The Aleutian Islands are

probably a relic of the land bridge by which travelled the mosses which are common to east Asia and north-west America. The list is composed of elements from Canada, Kamtchatka, and the Arctic Region. A. G.

Mosses of East Asia.—REIZO TOYAMA ("Spicilegium muscologiæ asiæ orientalis, 4," *Acta Phytotax. et Geobot.*, 1937, 6, 169–78, 5 figs.). Description of *Palisadula*, a new genus of mosses (Sematophyllaceæ) from Kyusyu, and of four new species of this and other genera from Japanese territory, also critical notes and revised synonymy of other species. A. G.

Japanese Mosses.—AKIRA NOGUCHI ("Studies on the Japanese Mosses of the Orders Isobryales and Hookeriales. III," *Journ. Sci. Hiroshima Univ.*, Ser. B, Div. 2, 1938, 3, 135–52, 8 figs., 2 pls.). Descriptions of eleven Japanese mosses from Formosa and other Japanese possessions. Five species of *Macromitrium* are new to science. The remaining species are carefully redescribed from type specimens. A. G.

Japanese Mosses.—AKIRA NOGUCHI ("Notes on Japanese Musci," *Journ. of Japanese Bot.*, 1938, 14, 25–32, 397–406, 11 figs.). Descriptions and figures of six new species of mosses from Japanese possessions, and notes on eleven other species which are new to the Japanese flora. A. G.

Thallophyta.

Algæ.

New Mexico Diatoms.—RUTH PATRICK ("The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis, New Mexico. Part V. Diatom Evidence from the Mammoth Pit," *Proc. Acad. Nat. Sci. Philad.*, 1938, 90, 15–24). The paper describes the diatoms observed in samples taken from a gravel pit between Clovis and Portales, New Mexico. The stratigraphy of the locality is indicated in the text-plate and the samples examined are listed in succession as they progress from the lowest stratum to the top of the excavation. The 140 species encountered are listed, and a series of letters is used to represent the relative abundance of a species throughout the various strata. The habitat or type of water in which the species is usually found is also indicated. Two strata only show evidence of possessing a true diatom flora, and from a study based upon the number of species and their relative abundance it appears that a flora existed in the lower strata, which was of speckled sand, that was fresh to brackish in type. Above this was a stratum of blue clay, and it is deduced that a decided freshening of the water occurred at the bottom of this stratum and a considerable increase in the diatom flora. In succeeding samples progressing upwards through the blue clay, a further change of the flora indicated an increase in the salt content of the water. The uppermost stratum of brown dune sand possessed no diatom flora.

N. I. H.

Maryland Algæ.—HAROLD C. BOLD ("Notes on Maryland Algæ," *Bull. Torrey Bot. Club*, 1938, 65, 293–301, 2 pls.). Two new species of Chlamydomonadaceæ are described, *Carteria ellipsoidalis* and *Chlamydomonas schizochlora*. Five other species of this and other orders are recorded as additions to the North American flora, and are discussed and figured. The asexual reproduction of *Pyramimonas* is described in detail. A. G.

Japanese Diatoms.—B. V. SKVORTZOV ("Diatoms collected by Mr. Yoshikazu Okada in Nippon. I. Mountain Bog Diatom Flora from Prov. Sinano," *Journ. of*

Japanese Bot., 1938, 14, 204-17, 2 pls.). This list comprises short diagnoses of thirty-three species and nine varieties of freshwater diatoms. Three species and eight varieties are new to science. One-third of these diatoms are of northern and alpine character. The plates contain sixty-four figures. A. G.

Shanghai Diatoms.—B. W. SKORTZOW ("Subaerial Diatoms from Shanghai," *Philippine Journ. of Sci.*, 1938, 64, 443-51, 2 pls.) A list of thirty diatoms obtained from an arboricolous moss specimen collected at Shanghai in May, 1933. Figures and short descriptions of the species and varieties are given; and three of the varieties are new to science. A. G.

Myxophyceæ.—FRANCIS DROUET ("Notes on Myxophyceæ, I-IV," *Bull. Torrey Bot. Club*, 1938, 65, 285-92). The first note is concerned with questions of nomenclature. *Johannesbaptistia pellucida* (Dickie) Tayl. & Drouet is a new combination; its synonymy and distribution are given. Then follow a list of six Myxophyceæ from Costa Rica; a list of fourteen Myxophyceæ from Argentina; and a list of fourteen North American Myxophyceæ in the Schweinitz herbarium at Philadelphia Academy. A. G.

Blue-Green Algæ.—HELEN FOOT BUELL ("A Community of Blue-green Algæ in a Minnesota Pond," *Ecology*, 1938, 19, 224-32, 2 figs.). An account of a freshwater community of blue-green algæ which in its early stages is benthic in ooze in pond-water 10 to 20 feet deep, and later rises to the surface buoyed by gases liberated in the globular mass during photosynthesis. The outer layer of the community is composed of trichomes of Oscillatoriaceæ; in the oozy interior are found unicellular planctonic blue-green algæ. Some of the Oscillatoriaceæ are violet-coloured species and give at times a red colour to the entire mass. A taxonomic account of the algæ is published elsewhere. A. G.

Pond Cyanophyceæ.—HELEN FOOT BUELL ("The Taxonomy of a Community of Blue-Green Algæ in a Minnesota Pond," *Bull. Torrey Bot. Club*, 1938, 65, 377-96, 12 figs.). A description of the blue-green algæ which form a community in a pond; they develop in ooze at the bottom of water 10 to 20 feet deep and later float to the surface. One new genus, *Cælomoron*, is described; it is a colonial member of the Chroococcaceæ. The new species described are *Cælomoron regularis*, *Holopedia pulchella*, *Spirulina æruginea*, *S. amethystina*, *Oscillatoria amethystina*, and *O. Leavittæ*. The last three of these are characterized in part by red pigmentation. *Merismopedia chondroidea* Wittr. is shown to be synonymous with *M. punctata* Meyen. A. G.

Japanese Cyanophyceæ.—YUICHI YONEDA ("Cyanophyceæ of Japan. I," *Acta Phytotax. et Geobot.*, 1937, 6, 178-209, 43 figs.). The first of a series of proposed papers on the Cyanophyceæ of Japan, which hitherto have been little studied. The present contribution includes eighteen genera, thirty-eight species, and five varieties, with brief descriptions, synonymy, and references. A. G.

Euglenineæ.—J. W. G. LUND ("Contributions to our Knowledge of British Algæ. VII. Some New British Algal Records.—II. Euglenineæ," *Journ. of Botany*, 1938, 76, 271-6, 2 figs.). A further contribution of algæ from ponds in Richmond Park, Surrey, with descriptive notes and figures of *Euglena pisciformis* Klebs, *E. mutabilis* Schmitz, *Phacus alata* Klebs var. *latviensis* Skvortzow, *Ph. ænigmatica* Drezepolski, *Ph. agilis* Skuja. A. G.

Alternation of Generations.—GILBERT M. SMITH ("Nuclear Phases and Alternation of Generation in the Chlorophyceæ," *Botanical Review*, 1938, 4, 132-9). A review of what is known of the life-cycles of unicellular and multicellular chlorophyceæ. A. G.

Catenella.—F. BOERGESEN ("*Catenella Nipæ* used as Food in Burma," *Journ. of Bot.*, 1938, 76, 265-71, 4 figs.). An account of an alga which is sold in packets at Amherst, Martaban, and used as food raw or cooked. It is *Catenella Nipæ* and is collected from mangroves in the estuary of the Salwin River. Mixed with it are a few fragments of two species of *Caloglossa* and two of *Bostrychia*. Descriptive notes and figures of all these are added. A. G.

Pogotrichum.—R. E. SCHUH ("On *Pogotrichum filiforme*," *Rhodora*, 1938, 40, 26-7). This alga was first collected in 1888 at Helgoland by Reinbold, and was found by Schuh at Vineyard Sound early in 1893, and subsequently at other places on the east coast of N. America. It also occurs at the Faeroes and Iceland. And the suggestion is made that in America it is a recent immigrant. A few notes on the structure of the alga are given. The American specimens are all monosiphonous, whereas most of the European specimens are polysiphonous. It has frequently been suspected that the plant may be identical with *Litosiphon pusillus* Harv. A. G.

Laminarin.—VINCENT C. BARRY ("The Preparation, Properties, and Mode of Occurrence of Laminarin," *Sci. Proc. Roy. Dublin Soc.*, 1938, 21, 615-22). A survey of the literature dealing with laminarin, and an investigation as to its composition. Laminarin consists exclusively of glucose, when hydrolysed by dilute hydrochloric acid. Kylin's view that laminarin is a mixture of closely related polysaccharides is not accepted by the author, who regards it as an unstable colloid with a rotatory power that increases uniformly with dilution (probably in proportion as the size of the colloidal molecule decreases). A simple method for the isolation of pure laminarin from *Laminaria digitata* fronds is described. Evidence is given which indicates the possibility that laminarin occurs in the alga as an ethereal sulphate complex. A. G.

South Coast Seaweed.—LILIAN LYLE ("Some Preliminary Notes on the Driftweed around Worthing," *Journ. of Bot.*, 1938, 76, 193-7). Rotting seaweed cast up on the south coast being found to be a nuisance in the holiday season, a quantity of the material was obtained from East Preston and carefully examined. A list of the determinations is given—four Myxophyceæ, twelve Chlorospermeæ, twenty-one Fucoideæ, twenty-nine Florideæ, as well as twenty-one epiphytes (with indication of their host plants). Notes are added on some of the species and on the nature of the sea-floor between Selsey Bill and Beachy Head. It is believed that the driftweed comes from various places and shoals along the coast. The local authority has had the weed, when offensive, carried out to sea and dumped there; this is but a temporary expedient. It would be better to dry the weed, cart it inland, and apply it burned or unburned to the fields. Another point is that the most harmless sewage effluent, owing to its large percentage of nitrogen, promotes the growth of certain algæ, which later become cast up on the beach and liberate a smell when decaying. A. G.

Spitzbergen Algæ.—W. KRIEGER ("Süßwasseralgen aus Spitzbergen (Conjugatæ und Chlorophyceæ)," *Ber. Deutsch. Bot. Ges.*, 1938, 56, 55-72, 2 pls.). A list of fifty-eight Conjugatæ and sixteen Chlorophyceæ collected on Albert I Peninsula and Andrée Land, northwest of Spitzbergen, by W. Jung during an expedition

in the summer of 1936. Forty-five samples were collected from the narrow strips of coast—on stones, in pools and swamps, in tufts of mosses, etc. Some of the species are purely arctic, others are arctic-alpine. A number of moss-dwelling Desmidiaceæ are common to the Arctic and to Middle Europe; on the other hand there is a marked absence of some genera of desmids which are widespread in Middle Europe. A few samples of coloured snow algæ were gathered. A bibliography is appended. A. G.

Bermuda Algæ.—FLORENCE RICH ("Notes on the Flora of the Bermudas.—Freshwater Algæ from Bermuda," *Journ. of Bot.*, 1938, **76**, 72–85, 5 figs.). A list of fifty-three freshwater algæ collected by the late Dr. A. B. Rendle in March and April, 1933, in Bermuda, from which small island scarcely any freshwater algæ have been recorded hitherto. They are mostly of wide distribution. Desmideæ are represented by four genera, diatoms by a dozen species, Flagellatæ by ten, Myxophyceæ by twenty. Among the Chlorophyceæ is *Cedogonium celandicum* Wittr., a species previously known from Sweden and Massachusetts. *Enteromorpha* and *Cladophora*, found in the brackish water of Spittle Pond, were thickly coated with a luxuriant growth of epiphytic algæ. A. G.

Dutch Charophyta.—H. D. VERDAM ("The Netherlands' Charophyta," *Blumea*, 1938, **3**, 5–33). An account of all the Charophyta recorded for the Netherlands with keys to the genera and species, descriptions of species and forms, distribution, critical notes. The number of species under the genera are *Nitella* six, *Tolypella* three, *Nitellopsis* one, *Chara* thirteen, and a number of forms. A. G.

Fungi.

Ancylistes.—H. BERDAN ("Revision of the Genus *Ancylistes*," *Mycologia*, 1938, **30**, 396–416, 22 figs.). The paper gives evidence for a more fundamental basis than mere infection by tubes instead of by zoospores for the separation of the genus *Ancylistes* from other members of the family, in that it has been found that in two species reproduction by conidia being forcibly discharged from conidiophores takes place. As a result of this study of *Ancylistes Closterii* and *A. Pfeifferi* reported from America for the first time it is concluded that the genus should be removed from the Ancylistales and placed in the Entomophthorales. F. L. S.

Achlya.—F. T. WOLF ("Cytological Observations on Gametogenesis and Fertilization in *Achlya flagellata*," *Mycologia*, 1938, **30**, 456–68, 9 figs.). It was observed that the development of the antheridia and oogonia of *Achlya flagellata* is like that of other species of the genus. A single mitotic division occurs in the sexual organs and there are apparently four chromosomes. A single nucleus is discharged from the antheridial tube into the oosphere, with which it fuses. F. L. S.

British Pyrenomycetes.—C. G. C. CHESTERS ("Studies on British Pyrenomycetes. II. A Comparative Study of *Melanomma pulvis-pyrus* (Pers.) Fuckel, *Melanomma fusciculum* Sacc., and *Thyridaria rubro-notata* (B. & Br.) Sacc.," *Tr. Br. Myc. Soc.*, 1938, **22**, 116–51, 2 pls., 5 text-figs.). As a result of his detailed cultural, morphological, and systematic study of *Melanomma pulvis-pyrus*, *M. fusciculum*, and *Thyridaria rubro-notata*, the author is inclined to believe that the Sphæriales and Pseudosphæriales can be differentiated by the former having symphogenetic stromata (formed mainly by coalescence of hyphæ) consisting in the main of synenchyma in which the perithecia arise from definite archicarps

that produce the perithecial wall, ascogenous hyphæ, and asci, while the Pseudosphæriales have meristogenetic tissue (produced by the growth and division of a few cells) composed of merenchyma within which an archicarp produces a hymenium of ascogenous hyphæ from which asci grow upwards into the pseudoparenchymatous or trabecular centrum of the stroma. As regards the three species investigated they are characterized by the dothideaceous-like development of the ascocarp and the persistence of its central tissues and should be placed in the Pseudosphæriales. F. L. S.

Thyronectria.—C. LEINEMAN ("Observations on *Thyronectria denigrata*," *Mycologia*, 1938, 30, 494–512, 47 text-figs.). An account of the morphology and development of *Thyronectria denigrata*, a Hypocreaceous fungus occurring on *Gleditsia triacanthos* in the eastern and central United States, and a discussion on whether *T. spherospora* is the same fungus affected by different conditions. F. L. S.

Ustulina.—W. H. WILKINS ("Studies in the Genus *Ustulina* with Special Reference to Parasitism. III. Spores—Germination and Infection," *Tr. Br. Myc. Soc.*, 1938, 22, 47–94, 13 text-figs.). An account of an investigation of infection of standing timber by spores of the temperate form of *Ustulina vulgaris*. Shape and size of spores are calculated and spore germination is described under varying conditions of temperature, age of spores, pH range, moisture, and nutrients and the degree of penetration of timber was tested. The conclusion is reached that infection by spores—apart from mycelial contact—is possible but not probable, and that experiments and examination of conidial infection are necessary. F. L. S.

New Sclerotinia.—P. H. GREGORY ("Sclerotinia polyblastis n.sp. on Narcissus, the Perfect Stage of *Botrytis polyblastis* Dowson," *Tr. Br. Myc. Soc.*, 1938, 22, 201–4). Apothecia of a *Sclerotinia* were found on over-wintered leaves of Narcissus killed in the summer by *Botrytis polyblastis*. Ascospores grown on agar media gave rise to cultures resembling those from conidia of *Botrytis polyblastis*, both macro- and microscopically. Neither ascospores from the *Sclerotinia* nor conidia from the *Botrytis* produced *Botrytis* conidia in artificial culture. But inoculation of Narcissus flowers from cultures of the ascospores produced characteristic *Botrytis polyblastis*. It is concluded that genetic connection exists between the two and the *Sclerotinia* is described and named *S. polyblastis*. F. L. S.

Microglossum.—S. IMAI ("Studies on the Geoglossaceæ of Japan. IV. The Genus *Microglossum*," *Bot. Mag.*, 1938, 52, 417–25). Descriptions and synonymy are given of five species of *Microglossum* from Japan. F. L. S.

Dermatea and Pezicula.—J. W. GROVES ("Dermatea acerina and Pezicula acericola," *Mycologia*, 1938, 30, 416–31, 8 figs.). Cultural and taxonomic studies were made of *Pezicula acericola* (Peck) Sacc. and *Dermatea acerina* (Peck) Rehm. The former, with its previously undescribed imperfect stage, *Cryptosporiopsis*, was found to be a typical *Pezicula* with oblong-ellipsoid conidia, and is considered to be distinct from *P. carnea* (Cooke & Ellis) Rehm. *Dermatea acerina*, with its imperfect stage *Sphæronema acerinum* Peck, differs from a typical *Dermatea* in having the oblong ellipsoid conidia characteristic of *Pezicula* F. L. S.

Smuts.—G. W. FISCHER ("Some New Grass Smut Records from the Pacific Northwest," *Mycologia*, 1938, 20, 385–96, 3 figs.). *Ustilago Sitanii* and *Tilletia pallida* are described for the first time in this account of new hosts and records mostly from the State of Washington. F. L. S.

New Agarics.—S. M. ZELLER ("New or Noteworthy Agarics from the Pacific Coast States," *Mycologia*, 1938, **30**, 468-74). Three species of *Agaricus* and two of *Lepiota* are described as new to science in this paper on eleven fungi. F. L. S.

Agarics.—A. A. PEARSON ("Agarics. New Records and Observations," *Tr. Br. Myc. Soc.*, 1938, **22**, 27-46, 3 pls.). This study of fungi new to Britain includes an account of two species new to science. These are *Tricholoma Inocybeoides*, belonging to the "terreum" group and distinguished from *T. argyraceum* by its smaller size, acute umbo, small spores, and unpleasant smell, and *Mycena uracea*, found on burnt ground and somewhat resembling dark forms of *Mycena galopus*. F. L. S.

Collybia radicata.—A. H. CAMPBELL ("Contribution to the Biology of *Collybia radicata* (Relh.) Berk.," *Tr. Br. Myc. Soc.*, 1938, **22**, 151-60, 2 pls.). The fruit-bodies of *Collybia radicata*, with their long-rooting bases, arise from subterranean tree-roots, as is well known, but what is less well known are the brown lines or plates found in the wood infected by this fungus. The significance of these brown plates was studied in this paper. They are composed of large branched hyphae forming a compact tissue cemented together by a brown substance. Cultures of the fungus were made and the brown plates developed. They have a similar structure and function as the rind of a sclerotium, and the term "pseudo-sclerotium" is suggested for them. F. L. S.

Clitocybe.—W. F. HANNA ("Notes on *Clitocybe illudens*," *Mycologia*, 1938, **30**, 379-85, 9 figs.). Cultures of *Clitocybe illudens* yielded diploid oidia and mycelium. The oidia on germination produce mycelium-bearing clamp connections. F. L. S.

New Boletes.—W. A. MURRILL ("New Boletes," *Mycologia*, 1938, **30**, 520-6). Species new to science are described for the following genera, one of *Gyroporus*, *Tylopilus*, and *Suillellus* respectively, and six of *Cerionmyces*. In the older nomenclature these would be species of *Boletus*. F. L. S.

Poria.—W. H. CAMPBELL and R. W. DAVIDSON ("A *Poria* as the Fruiting Stage of the Fungus causing the Sterile Conks on Birch," *Mycologia*, 1938, **30**, 553-61, 3 text-figs.). A brown *Poria*, possibly *P. obliqua*, was collected on badly decayed birch bearing sterile "conks" or sporophores. Identical fungi were obtained from cultures of the sterile conks and from the *Poria*. An account is given of the development and structure of the fungus. F. L. S.

Trametes.—W. R. HADDOW ("On the Classification, Nomenclature, Hosts, and Geographical Range of *Trametes Pini* (Thore) Fries," *Tr. Br. Myc. Soc.*, 1938, **22**, 182-94). A review of the nomenclature of this fungus is made in an attempt to overcome the confusion not only of synonymy but of forms. The fungus has a wide host range and is found commonly in Europe and northern Asia; it is also reported from India and the Orient, but the records from the southern hemisphere are doubtful. F. L. S.

New Tremella.—H. D. GORDON ("Tremella translucens, a New Species on Dead Pine Needles," *Tr. Br. Myc. Soc.*, 1938, **22**, 107-13, 1 pl., and 4 text-figs.). The fungus studied was comparatively abundant on dead leaves of *Pinus sylvestris*, near Peebles. The fructifications when moist appear as translucent, whitish globules, 4-3 mm. in diam., of gelatinous texture; when dry they are minute and brown or black. The hymenium covers the external surface of the fruit. The

spores are oval and no septation occurs. It is described as a species new to science and named *Tremella translucens*. F. L. S.

Taphrina.—A. J. MIX ("Species of *Taphrina* on North American Ferns," *Mycologia*, 1938, **30**, 563–80, 3 text-figs.). Ten species of *Taphrina* are described from American ferns, five of them new to science. F. L. S.

Imperfect Fungi.—H. N. HANSEN ("The Dual Phenomenon in Imperfect Fungi," *Mycologia*, 1938, **30**, 442–56, 4 figs.). Evidence is given that the mutants, saltants, sports, etc., observed in artificial cultures of Fungi Imperfecti are frequently not due to mutations of pure strains, but to the fact that many fungi in nature are composed of two distinct elements. This condition is referred to as "dual phenomenon." The cultures indicated that this phenomenon is due to individual cells and spores containing two genetically distinct nuclei. F. L. S.

New Hyphomycete.—E. YUILL and J. L. YUILL ("*Cladosarum olivaceum*. A New Hyphomycete," *Tr. Br. Myc. Soc.*, 1938, **22**, 194–201, 3 pls.). A fungus originally isolated from cultures of *Aspergillus niger* is described and made the basis of a new form-genus, *Cladosarum*, near the *Aspergillaceæ* among the *Moniliaceæ*. It is characterized by the sterigmata producing branched septate outgrowths which bear the single conidia. F. L. S.

Harposporium.—J. S. KARLING ("*Harposporium Anguillulæ*," *Mycologia*, 1938, **30**, 512–20, 18 figs.). As a result of cultural studies it is concluded that *Harposporium Anguillulæ* and *Polyrhina multiformis*, which are parasites of *Anguillula*, are identical and that the former name should be retained. In the present stage of knowledge it should be classed as a Hyphomycete and not as a Chytrid. F. L. S.

New Fungi.—G. W. MARTIN ("New or Noteworthy Fungi from Panama and Colombia. II," *Mycologia*, 1938, **30**, 431–42, 34 text-figs.). *Entonæma pallida* and *Mycomyxidium flavum* are two Basidiomycetes described for the first time. Both occur on wood. Microscopic details are given of their structure. Three other fungi are also described or recorded. F. L. S.

Florida Agarics.—W. A. MURRILL ("New Florida Agarics," *Mycologia*, 1938, **30**, 359–72). Twenty-two species belonging to twelve genera are described for the first time. They were all collected in Florida. F. L. S.

Japanese Fungi.—S. IMAI ("Symbolæ ad floram mycologicam Asiæ orientalis. II," *Bot. Mag.*, 1938, **52**, 357–63, 1 pl.). An account of nine Discomycetes found in Japan together with notes on their synonymy and geographical distribution. F. L. S.

Venezuelan Rusts.—F. D. KERN ("Additions to the Uredinales of Venezuela," *Mycologia*, 1938, **30**, 537–53). Twenty-two species are added to the previous lists of fungi from Venezuela, bringing the total to 205. In addition, notes on fourteen other species are made. Four species are described as new to science. F. L. S.

Cheese Mould.—S. DATILO-RUBBO ("The Taxonomy of Fungi of Blue-veined Cheese," *Tr. Br. Myc. Soc.*, 1938, **22**, 174–82, 1 pl.). The study was undertaken to determine whether the moulds of blue-veined cheese are distinguishable. The dominant mould was found to be *Penicillium roqueforti* Thom, which can be divided into three groups depending on colony characters. A variety new to science

was isolated from blue Cheshire cheese, *P. roqueforti* Thom var. *viride*. The fungus, on the other hand, from Dolce Verde was not *P. roqueforti* but related to *P. expansum*, the mould producing fruit decay.
F. L. S.

Aquatic Fungi.—E. M. BROWN ("Observations on the Aquatic Fungi of the Aberystwyth District," *Tr. Br. Myc. Soc.*, 1938, 22, 160–8, 2 text-figs., 1 map). Cultures were made from submerged twigs, leaves, and other debris collected about once a month one autumn and winter from pools and lakes around Aberystwyth. Eleven species of fungi were obtained belonging to the genera *Saprolegnia*, *Achlya*, *Isoachlya*, *Apodachlya*, and *Leptomitus*. The general ecology of the pools was also studied.
F. L. S.

Pansy Disease.—T. VAN EEK ("Root-Rot of *Viola tricolor maxima* Hort.," *Phytopath. Zeitschr.*, 1938, 11, 217–82, 18 text-figs., 3 pls.). An investigation, which included cultures and inoculation experiments, to determine the cause of root-rot and damping-off of pansies, revealed that a large number of fungi (several Phycomycetes, Tuberculariaceæ, especially *Fusarium culmorum*, and *Rhizoctonia Solani* and *Thielavia basicola*) are capable of producing the disease. Several of these have not previously been mentioned as originators of *Viola* root-rot. Two species, *Brevilegnia macrospora* and *B. gracilis*, are described as new to science.
F. L. S.

Yew Fungi.—E. O. CALLEN ("Some Fungi on the Yew," *Tr. Br. Myc. Soc.*, 1938, 22, 94–106, 1 pl., 3 text-figs.). *Sphærulina Taxi* (Cke) Massee, *Physalospora gregaria* var. *foliorum* Sacc. and *Anthostomella Taxi* Grove which were obtained from leaves of yew-trees in the neighbourhood of Edinburgh were studied in pure culture. *Cytospora taxifolia* Cke and Massee is shown to be the pycnidial stage of *Sphærulina Taxi* and its synonymy was studied. *Glaeosporium Taxi* Karst. and Har. and *Cryptocline taxicola* (Allesch.) Petr. were also recorded on the material examined.
F. L. S.

Lichens.

Central European Pertusariaceæ.—C. F. E. ERICHSEN ("Pertusariaceæ," *Rabenhorsts Krypt.-Fl. Deutschl., Oesterr. u. d. Schweiz*, 1935/6, 9, 5. Abt., Lief. 2/3, 321–728, 74 figs.). The family Pertusariaceæ is represented in Europe by the genera *Pertusaria*, *Melanaria*, and *Varicellaria*. *Pertusaria* is divided into four subgenera: *Eupertusaria* Erichs., *Ampliaria* Erichs., *Lecanorastrium* Müll. Arg., and *Variolaria* (Pers.) Erichs., distinguished by the form of the fruit-warts and the presence or absence of soralia. A new genus, *Melanaria* Erichs., is distinguished from *Pertusaria* by coloured spores; it contains four European species. Keys are supplied to the species of each genus and also to the varieties and forms of many species. In addition to the new genus referred to above, nineteen species, three subspecies, eighty-one varieties, and thirty-one forms are new to science. The illustrations are for the most part original, both photographs and line-drawings, and the latter are very successful in conveying a plastic impression of the habit and morphology of the thallus and apothecia.
I. M. L.

Lichens of the Moors and Thatched Roofs of North-West Germany.—F. TOBLER and F. MATTICK ("Die Flechtenbestände der Heiden und der Reiddächer Nordwestdeutschlands," *Bibliotheca Botanica*, 1938, Heft 117, 1–71, 14 pl., 2 maps). In the western part of the north German plain, in the neighbourhood of Oldenburg, the soil is a glacial alluvium, partly sandy and partly peaty. Its reaction is acid,

and this favours the growth of extensive associations of *Cladonia*, chiefly of the subgenus *Cladina*. The roofs with *Phragmites*-thatch, which are a feature of this region, also supply a favourable substratum for colonization by *Cladonia*. Some physiological experiments conducted in the field showed that these *Cladonia* were capable of absorbing overnight 12–17 p.c. of their weight of water in the form of dew. Attention was paid to the phenomenon of morphological convergence, whereby, owing to environmental agencies, distinct species of *Cladonia* may come to resemble each other to a marked degree. The plates illustrate the characteristic lichen-associations and the morphological convergences just mentioned. I. M. L.

Moor-Lichens of the Bohemian Massif and the Western Carpathians.—

J. SUZA ("Einige wichtige Flechtenarten der Hochmoore im Böhmischem Massiv und in den Westkarpathen," *Mém. Soc. Roy. Lettres et Sci. Bohême* (1937), 1938, no. 5, 1–33, 4 maps). *Cladonia incrassata* Flk. is a characteristic peat-lichen in the bogs of the Bohemian massif, i.e. Bohemia and the adjoining part of Lower Austria and parts of Moravia and Silesia; it occurs in every pine-forest bog. It may be a circumboreal species. Some other interesting lichens of these bogs are the following: (a) *Coriscium viride* (Ach.) Wain., an arctic-alpine species which may, however, occur in the bogs at lower levels; (b) *Parmelia olivacea* (L.) Ach., which follows the distribution of the birch; (c) *Cetraria sæpincola* (Ehrh.) Ach., which occurs on branches of the dwarf pine or of birch; and (d) *Evernia mesomorpha* Nyl., most frequent in alpine forests, on the bark of conifers. The last three species have circumpolar distribution, and reach their southernmost and southwesternmost limit in these Bohemian bogs. I. M. L.

Czechoslovakian Lichens.—J. NÁDVORNÍK ("Nouveaux et intéressants lichens de Tchécoslovaquie," *Mém. Soc. Roy. Lettres et Sci. Bohême* (1937), 1938, no. 20, 1–3). Notes on new or interesting lichens, mainly belonging to the Coniocarpaceæ, found in Czechoslovakia. *Calicium gneissicum* Nyl. and *C. fallax* Auersw. are found to be synonymous with *Coniocybopsis arenaria* (Hampe) Wain. *Embolidium Marianum* Nádv. is new to science. I. M. L.

British Lichens.—I. MACKENZIE LAMB ("Lichenological Notes from the British Museum Herbarium. II," *Journ. of Bot.*, 1938, 76, 153–65, 1 fig.). A number of rare or interesting species, including some new to the British lichen-flora, are enumerated. Detailed descriptions, based on a study of the type-specimens, are given of the following: *Lecidea cinerev-atra* Ach., *L. recens* Stirt. (= *L. arcuatula* (Arn.) Hue), *Cladonia ciliata* Stirt. (= *C. tenuis* Harm.), *C. subsylvatica* Stirt. (= *C. mitis* Sandst.), and *Buellia rysssolea* (Leight.) A. L. Sm. *Cladonia mitis* Sandst. and *Sarcogyne pruinosa* f. *atrosanguinea* H. Magn. are new to Britain. *Buellia disciformis* var. *triphragmia* (Nyl.) Oliv. must be expunged from the British lichen-flora, the specimen on which the record was based being *Leciographa inspersa* (Flk.) Rehm on the thallus of *Pertusaria corallina*. *Lecidea tumida* f. *glaucoæsia* M. Lamb is new to science.

S. A. MANNING ("Fauna and Flora of Norfolk Lichens," *Trans. Norfolk and Norwich Nat. Soc.*, 1938, 14, part iii, 303–8). A list of Norfolk lichens compiled from various sources and from the author's own records. A number of species have not been previously reported from Norfolk. The results of two recent surveys (Scolt Head Island and Wheatfen Broad) are also included. I. M. L.

Cornicularia normærica (Gunn.) D.R. on the West Coast of Sweden.—

T. E. HASSELROT ("Trenne Nya Lokaler för *Cornicularia normærica* (Gunn.) D.R. på Svenska Västkusten," *Svensk. Bot. Tidskr.*, 1938, 32, Häft 2, 209–12). *Corni-*

cularia normærica (" *Parmelia corniculata* " of the older floras) was previously known from only a few localities on the west coast of Sweden. The author succeeded in finding it in three more stations in this region. The species is more common in the subalpine tracts of Norway. I. M. L.

The Range of *Bæomyces placophyllus* in Germany.—H. SCHINDLER (" Beiträge zur Geographie der Flechten. III. Die Verbreitung von *Bæomyces placophyllus* Ach. in Deutschland," *Ber. Deutsch. Bot. Ges.*, 1937, 55, 530–9, 3 maps). The distribution of *Bæomyces placophyllus* Ach. in Europe may be termed northern suboceanic; in Germany it avoids the more continental southern and eastern regions, which are characterized by lower humidity. Unlike the Mediterranean-suboceanic species *Buellia canescens*, *Bæomyces placophyllus* penetrates northwards far into Scandinavia, and is not found south of the Italian alps. I. M. L.

African Lichens.—MARIA CENGIA SAMBO (" Licheni del Kenia e del Tanganica raccolti dai Rev. Padri della Consolata," *Nuov. Giorn. Bot. Ital.*, n.s., 1938, 45, 1–24). An enumeration of 124 lichens collected in a number of localities in Kenya and Tanganyika. As was to be expected, many of the species were found to be common to both these regions. Several South African species also were found to be present. A new genus of Cypheliaceæ, *Tylophoropsis* Ceng. Samb., is recorded, together with four new species (*Cyphelium Kenyanum*, *Tylophoropsis Nyeriana*, *Actinoplaca Bulboana*, and *Usnea epifilla*), eight new varieties, and two new forms. I. M. L.

The Lichens of the Second Byrd Antarctic Expedition.—P. A. SIPLE (" The Second Byrd Antarctic Expedition—Botany. I. Ecology and Geographical Distribution," *Ann. Missouri Bot. Gard.*, 1938, 25, 467–514, 6 pl., 1 map). The exploring party of the Second Byrd Antarctic Expedition, with its base at Little America in the Bay of Whales, returned from a three months' sledging journey through Marie Byrd Land, in the New Zealand sector of the Antarctic, with a rich collection of mosses, lichens, and algæ. The collection is the largest which has hitherto been made south of the 70th parallel. Ecological observations were made in the field with regard to the reactions of the lichens to substratum, light, and wind. Most of the lichens were found to occur on metamorphic sedimentary rocks, fewer on those which were purely igneous. Bird-rookeries were found to harbour rich colonies of the coprophilous lichens. The writer concludes that wind is probably the most effective agent in the distribution of lichens in the Antarctic regions.

C. W. DODGE and GLADYS E. BAKER (" Lichens and Lichen Parasites," *op. cit.*, 515–718, 28 pl.). A detailed systematic treatment of the foregoing collection. Keys to the Antarctic species of most of the genera dealt with are given. Eight genera had not been previously recorded from the Antarctic, and one, *Huea* Dodge and Baker, belonging to the Blasteniaceæ, is new to science. Trevisan's genus *Kutllingeria* is revived for Blasteniaceous species possessing an effigurate thallus, biatorine apothecia, and two-celled spores. Hue's composite genus *Polycauliona* is kept up, but Zahlbruckner, in the schedule of Krypt. Exs. Vindob. no. 1870, has shown that it embraces entities from at least two distinct families. One is struck by the apparently high degree of endemism revealed by the number of new species; of the seventy-five recorded only four were previously known. The anatomical descriptions are good, but it is to be regretted that the chemical reactions, which recent research has shown to be of prime importance in the classification of lichens, have been entirely neglected. I. M. L.

Various Expressions of the Lichen-Symbiosis.—H. DES ABBAYES ("Considérations sur la symbiose lichénique et ses différentes modalités," *Bull. Soc. Sci. Bretagne*, 1937, 14, 130-6) The nature of the lichen-symbiosis is still a matter of controversy. On one side it is claimed that the symbiosis is mutualistic, i.e. that both components benefit equally by the union; on the other, that it is antagonistic. Antagonistic symbiosis is considered by different workers to manifest itself in one or more of the following ways: (a) helotism, the domination and exploitation of the alga by the fungus, without resulting in the death of the former; (b) fungal parasitism, by the observed intrusion of hyphal haustoria into the algal cells; (c) endosaprophytism, the nourishment of the fungus on the dead remains of gonidia; and (d) algal parasitism, in which the lichen is supposed to represent a sort of gall induced by the irritant action of a parasitic alga on the fungus tissue. A notable feature in lichens is that the parasitism, if there be such, is controlled; there are fungi, such as *Endomyces scytonemata* on *Scytonema*, which live parasitically on algæ, but do not complete their life-cycles until the host has been killed by their agency; such cases of crude parasitism cannot be regarded as lichen-formation, and yet they probably represent the first steps whereby the more tolerant union was brought about. Certain organisms, again, belong to a category known as "half-lichens," in which the fungus occasionally comes into contact with an alga and forms a physiologically symbiotic union, but without the differentiation of any morphologically distinct lichen-thallus. Moreau's "algal gall" hypothesis appears to be disproved by the fact that the fungal components of certain lichens have been observed, in pure culture without gonidia, to produce the specialized tissues characteristic of the lichen-thallus; according to Moreau's view, such tissues could only be produced as a consequence of the irritation of the fungal hyphæ by intrusive parasitic algæ. The ideal conception of a mutualistic symbiosis, in which fungus and gonidia each make their contribution as partners to the common weal, finds little support in the facts hitherto observed. The inability of the fungal component to lead an independent existence, whilst the gonidia are capable of doing so, indicates that in the majority of cases a domination and exploitation, not necessarily harmful, on the part of the fungus is the prevailing condition. The author concludes, however, by pointing out that no unique generalization is likely to afford an explanation of the phenomenon of lichen-symbiosis, which is probably manifested in part at least as an expression of all the various tendencies enumerated above. I. M. L.

Lichen-Gonidia in Pure Culture.—JEANNE WERNER and R. G. WERNER ("Étude de quelques gonidies lichéniques isolées en culture pure," *Compt. Rend. Acad. Sci. Paris*, 1937, 204, 715-7). Gonidia from N. African material of *Xanthoria parietina* and *Lecanora allophana* were cultured on a medium of Knop's solution plus 2 p.c. glucose, with or without the addition of Asparagine, Peptone, or Ammonium nitrate. They formed well-developed colonies, different in appearance from those produced by the gonidia of European material of *Xanthoria parietina* and *Lecanora subfusca* respectively, and apparently belonging to distinct subspecies. They increased in culture by the formation of macro- and micro-sporangia, and, on media containing Asparagine, by zoospore-formation after a short period of freezing. The hymenial gonidia of *Endocarpon pallidum* (N. African material) formed viscous, shining colonies in pure culture, the cells increasing by binary fission; the algæ were referable to the genus *Pleurococcus*, belonging to a hitherto undescribed species. I. M. L.

Taxonomic Significance of Cephalodia.—G. T. JOHNSON ("The Taxonomic Importance and Phylogenetic Significance of the Cephalodia of *Stereocaulon*,"

Ann. Missouri Bot. Gard., 1938, **25**, 729–68, 3 pl.). Three morphological types of cephalodia may be distinguished in *Stereocaulon*: (a) the primitive spherical type; (b) the botryose or clustered type; and (c) the scrobiculate or pitted type, as placed in order of increasing complexity and differentiation. By a statistical analysis the author has found that this phylogenetic advance in the cephalodia goes hand in hand with an increase in the specialization of certain other morphological features, such as the form of the phyllocladia, height of thecium and hypothecium, and length and septation of spores. From this evidence he concludes that, although the nature of the Cyanophyceous algæ in the cephalodia cannot be employed as a taxonomic criterion (algæ belonging to different genera may occur in the same cephalodium), the form of the cephalodia themselves is a character which shows distinct correlation with the other morphological features, and hence may be used for purposes of classification. The view commonly held that cephalodia are injurious galls caused by the presence of foreign algæ certainly does not apply to *Stereocaulon*, in which they appear rather to exert a beneficial influence, probably due to nitrogen-fixing activities on the part of the blue-green algæ. The mode of origin and development of the three types of cephalodia was studied in detail by means of microtome-sections. One slip occurs on p. 736, where it is stated that cephalodia have not been reported in the Graphidineæ; Redinger has found them recently in *Opegrapha* (*Arch. f. Mikrobiologie*, IV, 237, 1933). I. M. L.

A Free-living Cephalodium.—R. DUGHÉ ("Une céphalodie libre lichénogène: le *Dendriscoaulon bolacinum* Nyl.," *Bull. Soc. Bot. France*, 1937, **84**, 430–7, 1 pl., 1 fig.). The fruticulose cephalodium of *Ricasolia amplissima* may occur in the free state, and has been in the past independently classified as *Dendriscoaulon bolacinum* Nyl. The identity of the two organisms has been placed beyond doubt by the discovery of individuals of "*Dendriscoaulon bolacinum*" bearing young lobes of *Ricasolia amplissima* on their secondary branches. This is the first reported instance of a cephalodium giving rise in nature to the normal lichen-thallus.

I. M. L.

Lichen-Chemistry and Taxonomy.—Y. ASAHINA ("Über den Taxonomischen Wert der Flechtenstoffe," *Bot. Mag., Tokyo*, 1937, **51**, 759–65). The doctrine of Zopf—"that neither substratum nor geographical position nor time of year is capable of exercising any influence on the lichen-acids"—has been fully confirmed by recent researches, and Nylander's use of the chemical characters as specific criteria appears fully justified. Acting on these premises, the author recently effected the dismemberment of the old collective species *Thamnolia vermicularis* into two chemically distinct entities, for one of which he proposed the epithet "*subvermicularis* Asahina." In one case thamnolic acid is present, in the other a mixture of squamatic and bæomyceic acids. Variations in the amount of a certain lichen-acid present, however, are not to be employed as taxonomic criteria, because their quantity is certainly affected by various environmental factors. It seems probable that symbiosis with different strains of gonidia may give rise to distinct lichen-acids; thus in the morphologically very similar species *Lobaria pulmonaria* and *L. retigera* the fungal component is probably identical in both, but in the former the gonidia are bright green, and blue-green in the latter; on this account their chemical constitutions are totally distinct.

I. M. L.

Production of Parietin by Lichen-Fungus.—E. A. THOMAS ("Die Spezifität des Parietins als Flechtenstoff," *Ber. Schweiz. Bot. Ges.*, 1936, **45**, 191–7, 1 pl.). The orange-yellow lichen-substance parietin, which gives the characteristic colour to the thalli of most members of the Teloschistaceæ and Caloplacaceæ, was

found to be produced by the isolated fungal components of *Caloplaca elegans* and *C. murorum* in pure culture without gonidia. This substance is therefore a product of the fungus alone, and not a lichen-substance in the strict sense. I. M. L.

TECHNICAL MICROSCOPY.

Die Verbesserung des Bildfeldes der Mikroskop-objektive (Planachromate).—H. BOEGEHOLD (*Z. f. wissenschaft. Mikroskopie*, May, 1938, **55**, 17–25). A description is given of a modified type of low and medium-power achromatic microscope objective for which improved flatness of field is claimed. E. E. J.

NOTICES OF NEW BOOKS

Faune de France. No. 34. Hyménoptères vespiformes. III. (Cleptidæ Chrysidæ, Trigonalidæ).—By L. BERLAND and F. BERNARD. 1938. vii+145 pp., 241 text-figs. Price 80 Fr.

No. 35. Diptères. Dolichopodidæ.—By LE CHANOINE O. PARENT. 1938. 720 pp., 1002 text-figs. Price 350 Fr. Published by MM. Paul Lechevalier et Fils, 12, Rue de Tournon, Paris (VIe).

Fishery Investigations. Series II. Vol. XVI.

No. 1. 1937. The English Plaice-Marking Experiments, 1929-1932. By C. F. HICKLING. Price 4s. net.

No. 2. 1938. The Sprat and the Sprat Fishery of England.—By J. ARMITAGE ROBERTSON. Price 4s. 6d. net.

No. 3. 1938. Phytoplankton and the Herring. Part III. Distribution of Phosphate in 1934-1936.—By MICHAEL GRAHAM. Price 2s. net.

Series I. Vol. IV. No. 1. 1938. An Investigation of the Effects of Milk Wastes on the Bristol Avon.—By F. T. K. PENTLOW, R. W. BUTCHER, and J. GRINDLEY. Price 4s. 6d. net. Published by H.M. Stationery Office, London and Edinburgh.

Micromethods of Quantitative Organic Elementary Analysis.—By JOSEPH B. NIEDERL and VICTOR NIEDERL. 1938. xvi+271 pp., 53 text-figs. Published by Chapman and Hall, 11, Henrietta Street, W.C.2. Price 15s. net.

Common Objects of the Microscope.—By the late J. G. WOOD. Third Edition, revised by W. J. FERRIER. 1938. xii+184 pp., 28 text-figs., 14 coloured plates. Published by George Routledge & Sons, Ltd., Broadway House, Carter Lane, E.C.4. Price 4s. 6d. net.

Animal Life in Fresh Water : A Guide to British Fresh-Water Invertebrates.—By HELEN MELLANBY. 1938. viii+296 pp., 211 text-figs. Published by Methuen & Co., Ltd., 36, Essex Street, W.C.2. Price 8s. 6d. net.

Mosquitoes of the Ethiopian Region. II. Anophelini : Adults and Early Stages.—By the late ALWEN M. EVANS. 1938. x+404 pp., 180 text-figs. Published by The Trustees, The British Museum (Natural History), Cromwell Road, S.W.7. Price 20s.

The Microscope.—Vol. II. No. 7. August, 1938 : pp. 169-196. No. 8, September, 1938 : pp. 197-224. No. 9, October, 1938, pp. 225-252. Published by Arthur Barron, Ltd., 20/21, Took's Court, E.C.4. Price 1s. per part.

Elements of Optical Mineralogy.—Part I.—By A. N. WINCHELL. 5th Edition. 1937. xii+263 pp., 267 text-figs., 4 plates. Published by Chapman and Hall, Ltd., London. Price 17s. 6d. net.

The fifth edition of this widely appreciated work does not differ greatly from the fourth edition. Apart from some corrections and additions, the main change rests in the inclusion of new illustrations of certain makes of polarizing microscopes. Nevertheless, the illustrations of Leitz, Swift and Winkel-Zeiss microscopes are the same as in the second edition of nine years ago, notwithstanding that much development has taken place during this period.

For the benefit of those workers with the polarizing microscope who are not already acquainted with this text-book, it may be mentioned that it has a large chapter on the use of the Federov stage which is noteworthy for the way in which it presents the technique in its simplest terms. Emmons' single and double variation methods are also fully described.

Chapter XII, which deals with the Nicol prism, could usefully be extended in future editions to include a brief account of the various types of polarizing prisms, and of methods of compensating astigmatism, so that the purchase of an advanced microscope would have some guide to salient features and the student would have a better appreciation of the optical design of his instrument.

There is a misleading statement on p. 135, which reads, "In the use of the Berek compensator the student must take two precautions not needed in using other accessories, such as the quartz wedge. He must be careful to

"1. Bring the crystal to be studied exactly to the centre of the field.

"2. Turn the crystal exactly 45° from extinction."

From 2, the student might suppose that the vibration directions of crystal and compensator need not coincide unless a Berek compensator is used, whereas no matter which type of compensator is used, true compensation can only be obtained if the fast direction of crystal and slow direction of compensator are parallel to within a degree or so.

E. E. J.

Les Infinites Petits Dans Leurs Manifestations Vitales.—By Dr. EUGÈNE PENARD. 1938. 212 pp., 75 text-figs., and 6 plates. Published by Georg & Cie., Corraterie 5, Genève.

The Author has gathered together in this book studies of a number of fresh-water Protozoa, carried out not on dead organisms in stained preparations but on the living forms in conditions as natural as possible. Several representatives of each group of the Rhizopoda, Heliozoa, Foraminifera, Infusoria, and Flagellata have been investigated. First, the morphology of the particular organism is stated, after which its movements, capture of food and feeding, and other features of its daily life are described, together with its resistance to deleterious conditions and agents, encystment, the reproductive cycle, and parasites, if any. Critical remarks on nomenclature and classification are also included.

It is a pleasure to meet with a book which deals with the *living* organism, and we commend it to the notice of those who are interested in the habits and daily life of these animalcules.

R. T. H.

Cryptogamic Botany.—By GILBERT M. SMITH. First Edition. 1938. Vol. I.—**Algæ and Fungi.** viii+545 pp., 299 text-figs. Price 24s. net. Published by McGraw-Hill Publishing Co., Ltd., Aldwych House, W.C.2.

Advanced students will undoubtedly find this a useful text-book and, as its statements are clear, any student of natural history will profit by dipping into it.

The first chapter discusses the important subject of classification and concludes that the conception of Thallophyta, combining the Algæ and Fungi, should be dropped.

The Algæ are divided into Chlorophyta, Euglenophyta, Pyrrophyta, Chrysophyta, Phæophyta, Cyanophyta, and Rhodophyta, based on the fact that each group is distinguished from the others by characteristic features in the structure, metabolism and pigmentation of the cell unit. The Stoneworts are included as a family within the Chlorophyta, or grass-green forms.

The various life-histories are clearly presented. A large number of the figures are original and many others are recent. Indeed, the figures, which are not unduly crowded, constitute one of the best features of the book. There are also a number of commendable diagrams.

As regards the Fungi, no view is expressed as to whether they are derived from the Protozoa or whether they are of polyphyletic origin. The Myxothallophyta are regarded as a natural group containing the slime moulds, the Phytomyxinæ (Plasmodiophorales), and the Acrasiales. The necessity for compression is clear in places, but on the whole the treatment is well balanced within the space available. A final chapter of ten pages is devoted to the lichens.

The treatment throughout is morphological without being cytological. In the account of conjugation in Spirogyra—a type so widely examined in laboratories that it might be supposed that no new thing could be found out about it—the recent work of Lloyd and of Miss Hazel Saunders has been overlooked. R. R. G.

Vol. II.—**Bryophytes and Pteridophytes.** vii+380 pp., 224 text-figs. Price 18s. net.

This companion volume to the *Algæ and Fungi* by the same author should be useful as a morphological survey of these groups, especially for general honours students who require a connected account without too much detail. The more important papers are referred to in the text and listed at the end of each chapter. This work naturally shows the influence of Campbell in many of the views expressed, and species and genera with an American distribution are chosen as far as possible for description. A large number of the figures are original and in the aggregate they make a considerable contribution to the subject of mosses and ferns.

The Anthocerotales are given a rank equal with that of Hepaticæ and Musci, and regarded as the probable ancestors of the Pteridophytes through the rootless Psilophytales. There appears to be much to be said for this view, on which botanists are not, however, yet agreed. A surprising omission from the literature is the well-known paper of Lang on the origin of the basal meristem in *Notothylax*.

As regards cytology, the policy has been to include rough accounts of antherozoid formation in various forms, but none of the work on chromosome numbers or sex chromosomes. Since chromosome numbers have become of considerable importance as indicators of relationships, we think they should now be included in a morphological work of this kind, especially as chromosome numbers are already finding their way into the recent Floras. Some account of the very clear history of the sex chromosomes in many Bryophytes could also be advantageously included, as well as a brief summary of the genetical work on such forms as *Sphærocarpos*, *Polytrichum*, and *Scolopendrium*. This would greatly help to link morphology with cytology and genetics. The genetical point of view with regard to changes in life-cycles and alternation of generations might also be discussed.

In the hepatics the account of the marsupia and water pitchers might have been less compressed, with some reference to their biology. The pyrenoids of *Anthoceros* are stated (p. 77) not to be homologous with those of green algæ; but the pyrenoids

of Hydrodictyon, with their peripheral portions transformed into starch grains, seem to be very similar. Less than thirty pages are devoted to the Musci, which seems hardly a fair share of the space.

The Pteridophytes occupy the bulk of the volume. The portion on stelar anatomy will be useful for students. There seems very little to quarrel with in the views of phlogeny and relationships expressed.

R. R. G.

Algæ: The Grass of Many Waters.—By L. H. TIFFANY. 1938. xiii+171 pp., 12 text-figs., 41 plates. Published by Charles C. Thomas, Springfield, Illinois. Price \$3.50, post paid.

This little book is intended as a popular introduction to an acquaintance with the algæ for the amateur. Chapters on "Algæ and the foods they make" and "How Algæ grow and reproduce" introduce the reader to aspects of the physiology of these organisms, such as the various pigments, their relation to wave-lengths of light and other radiations, and their metabolism. Short chapters follow on the Algæ of Lakes and Ponds; Streams and Rivers; the Sea; the Soil; Ice and Snow; and Algæ of Bizarre Abodes, in which statements about the Lichens are included. Among peculiar habitats might have been mentioned the forms which live in and on the dead or living shells of various Lamellibranchs and Gasteropods, both in temperate and tropical climates. Accounts of fossil algæ and the relation of algæ to various human affairs are followed by useful preliminary advice about how to collect and study algæ.

The author's treatment is by no means stereotyped. He livens his subject by frequent reference to recent scientific results in many fields, and shows himself *au fait* with a great deal of recent work bearing directly or indirectly on these organisms. The illustrations are from photomicrographs and fine drawings, two of the plates being in colour. A list of general references and an index complete the volume. It should stimulate an interest in the popular study of these plants and the many parts they play in nature. The student will, moreover, learn from it a great deal about the biology of algæ.

R. R. G.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, OCTOBER 19TH, 1938, AT 5.30 P.M., MR. J. E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed and signed by the President.

Deaths.—The President announced the regrettable loss to the Society, by death, of the following Fellows :—

William F. Dunlop.	Elected 1937.
Edward M. Nelson.	„ 1890.
A. W. Sheppard.	„ 1910.

The Fellows signified their condolence with the relatives by standing in silence.

Nomination Certificates in favour of the following candidates were read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

George Maclean.	Glasgow.
D. M. Munshi, B.Sc.	Bombay.
David C. Ramsden, L.D.S.	Leeds.
Walter W. Thornton.	Preston.

Donations were reported from :—

MM. Paul Lechevalier et Fils—

“ Faune de France.”

No. 33. Tuniciers. By Dr. H. Harant and Dr. Paulette Vernières.

No. 34. Hymenoptères vespiformes. III. By L. Berland and F. Bernard.

No. 35. Diptères Dolichopodidæ. By Le Chanoine O. Parent.

Dr. Eugene Penard, Hon. F.R.M.S.—

“ Les infiniment petits dans leurs manifestations vitales.” By Eugene Penard.

McGraw-Hill Publishing Co., Ltd.—

“ Cryptogamic Botany.” First Edition.

Vol. I. Algæ and Fungi.

Vol. II. Bryophytes and Pteridophytes. By G. M. Smith.

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“Algæ: The Grass of Many Waters.” By L. H. Tiffany.

Dr. Guiseppe de Toni—

Supplement to J. B. de Toni's “Sylloge Algarum.” Parts III and IV. By Guiseppe de Toni.

Mr. C. T. Owen, F.R.M.S.—

“Rare and Remarkable Animals of Scotland.” Vols. I and II. By Sir John Dalryell.

“Life of the Shore and Shallow Sea.” By Douglas P. Wilson.

Collection of miscellaneous separata. 10 miscellaneous micro slides.

Mr. J. M. Coon—

Collection of original micro-botanical drawings.

Votes of thanks were accorded to the donors.

Papers.—Prof. L. C. Martin, D.Sc., described an exhibit of experimental rulings by the late Mr. H. J. Grayson. A discussion followed:—

MR. CONRAD BECK.—The majority of the Grayson rulings that came to this country passed through the hands of my company. In the early days they not infrequently arrived with a layer of crystals obscuring the lines. Mr. Grayson had told us to return any in which this occurred and he could readily put them right. This rather confirms the suggestion that the crystals were in the mounting material and not in the realgar.

Mr. Rheinberg was the first to discover that the rulings were made on the realgar and not on the glass. He sent me a specimen in which the layer of realgar had split and the lines had shifted with the realgar so that they were no longer continuous.

Shortly after this I met Mr. Stone, a clever engineer from Melbourne, who had collaborated with Mr. Grayson in the manufacture of his machine. When I told him that we had found that the lines were ruled on realgar, he laughed and said that no one had discovered it before; he then described the method alluded to by Dr. Martin by which the realgar was evaporated upon the cover-glass.

It was hoped that these lines might form a useful standard for fine reference, but the National Physical Laboratory decided, and no doubt quite rightly, that the realgar did not make a sufficiently stable basis for a standard. The lines thus

ruled on realgar are exceedingly regular even up to the finest 120,000 lines to the inch, and are vastly superior to the fine lines of Nobert which were ruled on glass and are in some cases like a row of chips.

For the interferometer apparatus made for Dr. Tutton to use for the calibration of the standard yard in wavelengths, I induced Mr. Grayson to make a number of rulings each of which consisted of 5 lines $1/40,000$ of an inch apart. They were used as signals for setting the microscopes of the apparatus in the step-by-step method of wavelength counting.

These were ruled on glass and on silver and were quite perfect lines, showing that up to that degree of fineness Grayson had succeeded in ruling fine lines on glass.

Many years back, Mr. Mayall obtained the ruling machine of the late Mr. Nobert and exhibited it at our Society. He spent a large amount of time endeavouring to make rulings and met with no success. The difficulty was to obtain a sufficiently fine and perfect diamond point. That is the greatest difficulty that anyone attempting to make fine rulings will have to overcome. I should expect that it might take perhaps a year or two to overcome this difficulty. When that is done the other difficulties could probably be readily dealt with.

DR. E. E. JELLEY suggested that the crystals might be orthorhombic sulphur, as sulphur is appreciably soluble in hot benzol- or xylol-balsam. The sulphur might have been dissolved from the sulphur-realgar film, or might have been added to the Canada balsam solution deliberately in order to prevent dissolution of sulphur from the film. He enquired whether Professor Martin had examined the crystals under the polarizing microscope, as orthorhombic sulphur, in certain orientations, possessed high birefringence.

Professor Martin replied that he had done so, and found that the crystals were strongly birefringent and showed strong relief, which indicated a high refractive index.

Mr. S. R. Wycherley, F.R.M.S., communicated a paper on :—

“Photomicrography and Record Photography with Dufaycolor.”

Votes of thanks were accorded to Professor Martin and to Mr. Wycherley for their communications.

Announcement.—The Secretary made the following announcement :—

The Biological Section will meet in the Pillar Room on Wednesday, November 2nd, 1938.

The Proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD IN THE HASTINGS HALL, BRITISH MEDICAL ASSOCIATION HOUSE, TAVISTOCK SQUARE, LONDON, W.C.1, ON WEDNESDAY, NOVEMBER 16TH, 1938, AT 5.30 P.M., MR. J. E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding meeting were read, confirmed and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

George Maclean.	Glasgow.
D. M. Munshi, B.Sc.	Bombay.
David C. Ramsden, L.D.S.	Leeds.
Walter W. Thornton.	Preston.

Nomination Certificate in favour of the following candidate was read for the first time and directed to be suspended in the Rooms of the Society in the usual manner :—

Charles Bunnin.	Wembley.
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Death.—The President announced the regrettable loss to the Society, by death, of the following Fellow :—

Sir Robert Mond.	Elected 1911.
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A vote of condolence with the relatives was passed.

Donations were reported from :—

Mr. Martin E. Moseley—
 “ Microscopic Observations.” Notes collected by the late Rev. H. G. W. Aubrey (c. 1860–1890).

Mr. S. H. Robinson, F.R.M.S.—
 “ The Marine Plankton.” By J. Johnstone, A. Scott, and H. C. Chadwick. 1934.

Mr. J. A. Long, F.R.M.S.—
 56 type slides of diatoms.

Mr. F. W. Mills, F.R.M.S.—
 2 type slides of diatoms.

Mr. N. Ingram Hendey, F.R.M.S.—
 2 type slides of diatoms.

Rev. Dingley P. Fuge, F.R.M.S.—
 1 species slide of diatoms.

A vote of thanks was accorded to the donors.

Signing the Roll.—The following gentlemen subscribed their signatures to the Roll of Fellowship :—

Mr. Edwin Burgess.
 Mr. T. W. Dudley-Ward.
 Mr. Andrew More.
 Dr. W. J. Purdy.
 Mr. D. C. Ramsden.
 Mr. R. Ross.

Papers.—The following communications were read and discussed :—

Dr. J. P. Harding—

“ A Simple Instrument for Dissecting Minute Organisms.”

Mr. F. J. Aumonier, M.Sc.—

“ Notes on the Distortion of Paraffin Sections.”

Votes of thanks were accorded to the authors of the foregoing communications.

The Following Paper was read in title :—

Dr. W. W. Hansen—

“ On a New Design of Micromanipulator.”

Announcement.—The Secretary made the following announcement :—

The Biological Section will meet in the Pillar Room on Wednesday, 7th December, 1938.

The Proceedings then terminated.

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